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THE ELECTRICAL TRANSMISSION OF POWER.

THE results of M. Marcel Deprez's experiments at Grenoble will be found tabulated at length in our columns this week. Nothing new or startling has been brought forward, and we fail to see, either from a scientific or a commercial point of view, that M. Deprez has advanced the cause of the electrical transmission of power to any considerable extent. Energy, to the extent of 7 horse-power, has been received through a silicious bronze wire of small section from a distance of 14 kilometres, a dynamo-electric machine of special construction, driven by a turbine, furnishing the electricity.

It would scarcely be kind on our part to criticise the data given by the experimental committee, because the motive power, being derived from a waterfall, does not enter into the question of the cost of production of the transmitted power. Therefore, if only 15 or 20 per cent. of such energy can be conveyed to a distance—and no one has doubted this, although M. Deprez's partisans in France endeavour to persuade the public that he has made a great discovery—it is of some consequence to the industrial world.

We cannot, however, refrain from remarking, that the figures given, as was the case in the Miesbach-Munich and Great Northern experiments, are open to grave doubts. It is generally noticeable on such occasions, that the experimental committee is only able to make use of a limited selection of apparatus; and, also, that losses on the line are ignored. Leaving our readers to form their own opinions as to the *accuracy* of the Grenoble experimental data, we would at present only ask if such tests are now of any special value. It is scarcely likely, if the electrical transmission of power is to become commercially successful on a large scale, that silicious bronze wire of 2 mm. diameter will be employed as a conductor; indeed, we should imagine that telegraph wires of the present kind would be used only as a last resource. By this we mean, when copper is no longer procurable at reasonable cost. Such experiments, therefore, as those in which M. Deprez has been so energetically engaged during the last two years, appear to us somewhat premature and out of place.

Electrical engineers will certainly regret the omission of electrical data when the proportion of resistance of the machines to that of the line is taken into consideration. Had this been tabulated it would have enabled one to check the results of the dynamometrical measurements. Instruments for the purpose might surely have been obtained with but little trouble.

It is unpalatable to us to be obliged to cast doubts upon the genuineness of M. Deprez's experiments, both in the present case and in those of a prior date; but their continual recurrence, with a certain sameness of results, combined with the manner in which they are heralded by certain of our French contemporaries, lead us to the belief that they are purposely made subservient to some intended gigantic financial speculation.

THE BRITISH ASSOCIATION MEETING AT SOUTHPORT.

(*From our Special Reporter.*)

(*Continued from p.* 237.)

TALKING BY ELECTRICITY.

On Saturday evening Sir Frederic Bramwell, F.R.S., delivered a popular lecture to the working classes in the circus, which was crowded, on "Talking by Electricity-Telephones." Having explained the mechanical construction of the telephone, his demonstrations being facilitated by the instrument itself and numerous diagrams, the lecturer said, that looking at the fact that the telephone was now an instrument in daily use, both commercially and socially, it was difficult to believe that it was only six brief years ago that, at the Plymouth meeting of the association, the telephone was for the first time explained by its talented inventor, Mr. Graham Bell, assisted by Mr. W. H. Preece, the electrician to the Post-office, and thus, although the telephone had now become an instrument of every-day use, it was probably one of the newest instances of the applications of science for the purposes of man. Now, however, as the telephone was, it depended, as indeed all inventions did, upon the application of well-known natural laws. The first of these laws was that relating to the generation and transmission of sound, which he illustrated by experiments, establishing these propositions: That a source of sound—the human voice—sets up waves in the air; that these waves can put a plate into vibration, and that if similar vibrations can by any means be given to another plate, that other plate will communicate to the air, vibrations similar to those that had operated upon the first plate, and that there will be a reproduction of the speech; that if a coil of wire be moved in the neighbourhood of either a permanent or of a temporary magnet, electricity will be generated; that its direction will depend on that of the motion of the coil, and its strength, to use a popular term, will vary with the nature of the motion; that an electro-magnet can be made by the passage of a current of electricity. These were the elements necessary to enable a telephone to be understood. In thinking out his invention, Mr. Bell set himself this double problem: "I know that speech can make a disc vibrate; but, knowing that, I do not know whether that vibration can be made to correspondingly influence electric currents, and if so, I do not know that the currents so influenced can be utilised for the production of a similar vibration to that which had thus generated or controlled these currents." That was the double problem that he set himself. He then investigated what had been done up to his time, and he depicted it, so as to have graphically before him that which had been accomplished. The lecturer asked the audience to look at a diagram, where they would find a line with shaded parts above it, then spaces, then shaded parts, and then spaces. That Mr. Bell intended to represent graphically a current, a cessation, a current, a cessation; and this succession he termed intermittent electricity. In the next diagram the shaded parts above the line were much wider apart than they were before, and that below the line in the middle of the spaces had shaded parts corresponding to the parts above. That was intended to represent, first electricity in one direction, then cessation; then electricity in the opposite direction, then cessation; then electricity in the first direction, and so on; and these Mr. Bell called reversed intermittent electricity. In another diagram they saw very nearly the same thing as in the last one, except that the sides of the bottom shaded parts were brought just below the sides of the top ones without any spaces; this was to show that a current in one direction was immediately succeeded by a current in the opposite direction. That Mr. Bell called pulsatory. In another diagram they had a line with a shaded height above it at all times; but that height abruptly increasing and decreasing, represented a continuous current suddenly added to or suddenly deducted from, but, nevertheless, the current always in one direction; and that Mr. Bell called direct undulatory. They would see that according to the diagrams a telephone could be made without any electric battery at all, and that each receiver or transmitter (for they acted alternately as one or the other) generated its own current by the vibration of the disc. In the telephone where there was no battery the electricity inevitably must be feeble, for it was nothing but what arose from induced electricity caused by the almost imperceptible vibrations of the discs. Even where there was a battery, whether used by one or other of the two modes to which he had called attention, that which he had ventured to call the operative electricity, must still be feeble, for that, after all, was produced by nothing but the vibrations of the discs. Mr. Bell saw another mode of dealing with the operative elec-

tricity; that was to have a battery to generate the current, but to vary the transmitting power of the conductor, and in that way to vary the current. He, however, only suggested one plan of doing it, which was by a water connection. This had been suggested before, but it was found not to be feasible, and it was given up. Mr. Edison dealt with the telephone transmitter upon the principle of varying the power of a conductor, the electricity being provided from an extraneous source. Mr. Edison did not stop at the transmitter; he set himself to work to make a receiver. Prior to Edison's time it was known that the passage of electricity through certain substances varied the friction of bodies moving in contact with them. Notably it was found that the passage of electricity through the human frame varied the friction of any substance against the tissues. It was found that when a man was in an electric bath, and rubbed his finger along the bath, he, as the current was varied, perceived he rubbed it with a differing friction. Among the bodies, the friction of which was sensibly changed by the variation in the current passing through the surfaces in contact, was chalk, and Mr. Edison availed himself of this in the construction of his chalk-receiver. He asked attention to a further most wonderful invention by Mr. Graham Bell, which, although it probably would never be of commercial value, deserved consideration as illustrating the extraordinary fidelity with which electricity could reproduce at a distance the vibrations of a plate moving under the influence of speech. This was the photophone. There was a material, selenium, which, as discovered some years ago by Mr. Willoughby Smith, varied in its power of conducting electricity according to the amount of light to which it was subjected, and one apparatus that had been used to show this was a selenium eye made by Sir William Siemens. He had one of these eyes, which he coupled to a galvanometer, and as he opened and closed the eyelids the galvanometer moved in response. It was by the use of that material—selenium—and in virtue of its property of variation in its conductive power that Mr. Graham Bell was enabled to construct the photophone. He said, "If I can get beams of light to vary under the effect of the voice, and can cause them to impinge upon selenium properly arranged, I ought to be able so to vary the conducting power as once more to put a Bell receiver into action, and bring forth a repetition of the sounds that varied the beams." Mr. Bell effected this by making the back of the disc a mirror, so that when the disc was spoken to its vibrations made corresponding variations in a beam of light. This being thrown on to a selenium cell varied the current of electricity passing through it to the receiver, and made it speak. By this contrivance they were enabled to communicate speech across a river, for example, or to a place where they could not get a wire or any electrical communication, and to do so by a beam of light. Some years ago much amusement was caused by an indignant magistrate saying to an old offender, "What do you mean, sir, by looking at me in that tone of voice?" Mr. Graham Bell had rendered it possible for the selenium to make such a remark to a speaker without being guilty of a confusion of language. Having thus described the two kinds of telephones—Professor Graham Bell's and Mr. Edison's—he asked the audience to consider some of the uses of the inventions, and explained the private wire and the Exchange systems. There was also one system at work in America known as the Law system, where there was a separate wire for the call—not a separate wire for each instrument, but a wire that went along and took, perhaps, ten or fifteen subscribers in one line, along which any one of these subscribers could speak direct into the Telephone Exchange to an attendant, who wore a perpetual head-dress which contained the permanent magnet—and in that way he was always listening to what was taking place. When a subscriber wanted anything he simply called along the wire, and his want was heard without the necessity of any inquiry, and thus time was saved. Of course, there was this difficulty, that the wire, for economy, being common to many subscribers, it might be that when you wanted to talk to the exchange somebody else was using it, and you had to wait a little. But it seemed to him to work extremely well when he saw it in New York. There were also other uses for the telephone. They could use it, as the *Times* did, to convey intelligence to the compositor, who had a head-dress nearly of the same kind as that which he had described, heard what was said to him, and straightway composed it. It was obvious that there must be many other uses of the telephone, but they could imagine them for themselves as well or better than he could tell them. The adoption of the telephone, continued the lecturer, has spread much more rapidly in America than it has here. For example, Washington has a population of about 120,000 white inhabitants and 60,000 coloured. This population uses 800 telephones. Everything in Washington is done by telephone, and the people do not seem to know how to get on without it. I am glad to say, although we do things very slowly here, the telephone is at last progressing in England. The United Telephone Company, in their circular of the 1st of March last, showed that on the 28th of February, 1881, there were connected to the Exchange in London (I am leaving out all private wires) 845 persons; on the same day in 1882, 1,505, an increase of 660; and on the same day in 1883, 2,531, an increase of 1,036 in the year. I think it is clear that that sort of increase ought to go on in more than arithmetical ratio, because the temptation to subscribe must increase with the increase of your speaking power to a large number of persons. No one would care to join if there were only a dozen to speak to; but when it is found that almost every man has a number in the telephone book, you say, "I had better belong to it, because I can then talk to all these people." Therefore, as the numbers increase, this very increase will tempt others to join. With the increased number of subscribers there comes, as a consequence, and all but inevitably, a greater use of the telephone by each subscriber. It appears that in March last the average daily calls of each subscriber were 7·59: each call represents two messages, but if you take it as representing only one you will find, unless my arithmetic has gone wrong, that a payment of £20 a year represents 2d. for each call, or, taking the call and answer, the message each way costs 1d. The number of calls steadily increases, and, as I have said, it is obvious that as the number of subscribers increases the frequency of calls will increase from each subscriber, because he has more persons to talk to. Going to another point, that of the line wire connection, the extreme delicacy of the telephone renders it very liable to disturbance by induced currents. I have spoken hitherto of the telephone as though there were always a complete out and home wire circuit, but as a matter of fact the circuit is a wire only one way, and the earth is used the other way. There are certain persons, however, who insist on having an entire metallic circuit. If you use the earth you are liable to a variety of disturbing causes from earth currents, and if you have a powerful dynamo-machine, employing the earth as part of its system, in the neighbourhood you get some very extraordinary results. To show the great delicacy of the telephone, I may mention that when the telephone was first introduced I was speaking along one, the wire of which was carried on telegraph posts on which there was another wire conveying Morse signals, and all those Morse signals could be heard in the telephone simply by the induction from one wire to the other. If you have a metallic circuit, you have the two wires, out and home, very close together, and if you have them insulated and twist them, you get rid of a great deal of this evil effect, and you do it in an intelligible manner. Suppose the effect of induction from a neighbouring wire is to add or deduct from that which is going on in the telephone wire. Think of it as you would of a pair of scales. If you have a pair of scales, and you put one pound in each scale at the same time, or if you take out the two at the same time, you do not disturb the balance. If, therefore, you have these wires close together and close to the disturbing influence, that influence acts equally on both wires, and it is as though you put one pound in each scale at the same time, or took out one pound at the same time—that is, you do nothing at all. In that way you get rid of the difficulty. I have an apparatus here which, if time permits, will show this. With respect to the distance through which messages can be transmitted telephonically, in March last I was informed from a trustworthy source that 190 miles were being commonly and successfully worked. Since then I have been told—but I do not vouch for it—that as much as 1,000 miles have been experimentally accomplished. I believe that the limit of distance will be found to depend upon the perfection of the insulation and the absence of inductive currents. Common as the telephone now is, let me remind you that if but six short years ago it had been suggested to you that we should within two years of that time be able to reproduce at a distance not merely sounds but articulate speech, and not merely articulate speech but every trick and accent of the voice of the sender, so that any one listening could say, "That's my friend," or "That is a stranger," or "That is a Scotchman," or "That is an Irishman" who is speaking, would you not have scouted it as the language of an enthusiast? Yet it is but six years ago. In this age the world very soon becomes accustomed to marvels; it does not wonder long—not even the proverbial nine days. I believe if to-morrow you found a man comfortably flying from the top of this building to the end of the pier, and alighting there without injury, it might attract spectators for about a week to see a daily repetition of the flight, and at the end of that time they would pay no more attention to it than if they had been in the habit of seeing men fly ever since they were born.

The lecturer's illustrations excited much interest, and his allusions to the commercial value of the telephone were loudly applauded.

MECHANICAL SCIENCE.

Monday, September 24th.

ON ELECTRIC LAUNCHES.

By Mr. A. RECKENZAUN.

In treating this subject I have taken into consideration the fact that I have the honour of addressing many members of the engineering profession, and that to them one fact is worth any number of speculative theories; hence I have thought well, tempting as the occasion is, to abstain from indulging in prophecies, and confine myself purely to a description of what has been accomplished in practice, and of the results of experiments connected therewith.

Jacobi's and Trouvé's ingenious experiments are well known and appreciated, but the data furnished by these *savants* afford us very little encouragement to pursue the matter in the paths chosen by them, since the said experiments merely demonstrated a philosophical possibility rather than presented the solution of the problem in a practical light.

The idea of utilising primary batteries, which depend upon the consumption of zinc, for motive power purposes cannot hold good, since we have the means of converting steam and water power into electrical energy through highly efficient dynamo machines, and since we are enabled to reconvert electricity into mechanical power by means of highly efficient motors.

Our first and principal desideratum for the purpose of propelling a boat was a portable and detached medium, capable of holding the electric current generated by the dynamo machine; a storage battery of great capacity and comparatively of small weight, capable of dealing the accumulated energy out in large or small quantities with very little loss, and these desirable qualities were furnished by the Faure-Sellon-Volckmar accumulator. Within the last 12 months two launches have been fitted out by the Electrical Power Storage Company at Millwall, the object in view being to demonstrate that sufficient electrical energy can be stored within the hulls to enable them to make a journey of from 50 to 60 miles at a fair rate of speed with one charge. The essential points of difference between the two launches lie mainly in their external dimensions and the means adopted for transmitting the power from the motor to the screw propeller. The first vessel, named *Electricity*, was launched at Millwall in September, 1882; she is 25 feet long, 5 feet beam, and draws 21 inches forward and 30 inches aft, with 10 passengers on board. 45 accumulators, stored under the seats and decks forward and aft, supplied the current to two D3 Siemens' series dynamos, placed side by side on the floor of the boat, with their axes parallel to the propeller shaft.

To construct a screw propeller to run well at nearly 1,000 revolutions per minute was then considered a new departure, involving elaborate experiments, therefore it was resolved to employ some intermediate gearing, suitable for the occasion, giving the screw 350 revolutions, whilst the motors ran at 950 revolutions. A Collis-Brown two-bladed propeller of 20 inch diameter and 3 feet pitch was employed in these first experiments. On the screw shaft was keyed a pulley, driven by a strap from a smaller pulley, on an overhead countershaft. On the same countershaft two other pullies, one of which was provided with a friction clutch, received their motion from the two dynamos or motors on the floor. This boat, with the gearing, was illustrated in *Engineering* and in the ELECTRICAL REVIEW soon after the first trip; it is, therefore, unnecessary to go into any minute description of mechanical details, and the electrical arrangements may be found to be more interesting.

The two motors were coupled in parallel circuit, whereas the cells were arranged in series. Each machine had its own switch and ammeter, and the starboard machine could be stopped mechanically by means of a friction clutch. No better (dynamos) motors could be found for equal power, weight, and space than the Siemens' horizontal machine. Previous to placing them into the boat these machines were subjected to a series of tests with the Prony brake, at various speeds and powers, to ascertain the most convenient conditions for working, and a few of the results will be found in the following table, referring to one of two identical machines:—

TABLE I.

D3 SIEMENS' MOTOR. RES. ·77 OHMS.

E. M. F.		Revolutions per Minute.	Current in Ampères.	Brake H.P.
Battery.	Motors.			
70·44	63·33	704	21·47	1·40
,,	61·10	528	28·44	1·65
,,	64·46	1008	13·82	1·00
100	84·30	950	21·0	1·86
,,	82·12	694	33·25	2·78
106	86·04	780	33·68	3·12
,,	89·68	1124	21·01	2·56
116·5	94·07	946	27·97	2·83
,,	96·27	1226	21·35	2·45

One of the trial runs from the wharf of the company's works at Millwall to the Old Swan Pier, London Bridge, took 23 minutes, returning to Millwall in 30 minutes, the tide being in favour of the up journey. On this trip we carried 47 cells and four passengers. The two motors running simultaneously absorbed a current of 46 ampères, while the propeller shaft revolved at 360 revolutions per minute. When disconnecting one of the motors, the current passing through the other was 33 ampères, and the speed of the screw shaft fell to 250 revolutions. The single motor must have developed about 2·75 H.P. on the shaft, whereas the two motors combined, with a current of 23 ampères each, gave about 3·75 H.P. according to the nearest test in the above table.

The single motor had to work up to its maximum capacity, which is 2·78 H.P. with an E.M.F. of 100 volts, and the reduced speed of the screw corresponds to the increase of current. These results demonstrate the fact that, with a given E.M.F. the current is proportional to the load, so long as the motor is capable of absorbing larger currents without loss of efficiency.

The following table (II.) gives the results of tests made with this same motor when running without any external work, it shows how much energy is absorbed by the machine itself. The speed of the armature varies directly with the E.M.F. whilst the current remains practically constant, the weight of the armature, and friction, may in this case represent a constant load.

In all these tests the angle of the collecting brushes was the same, as the reversing lever did not permit of any adjustment.

It would be erroneous to take these figures as the equivalent of the losses going on in this electromotor when doing external work, because then certain conditions will be altered. As the current increases with the load, so the waste of energy due to heating of the wires increases; the friction in the bearings, moreover, will be greater, in proportion to the extra pressure upon the armature spindle.

TABLE II.

D3 SIEMENS' RUNNING WITHOUT LOAD.

E.M.F.	Current.	Revolutions.	$\frac{E \times c}{746}$.
9·24	2·3	400	·028
11·88	2·3	538	·036
13·20	2·4	580	·042
15·18	2·5	700	·050
17·16	2·6	784	·059
18·48	2·6	862	·064
23·76	2·8	940	·089
27·06	2·9	1180	·105
29·04	2·9	1232	·112
33·00	2.9	1384	·128
34·32	2·9	1584	·133

At 1,226 revolutions, with 116·5 volts and 21·35 ampères, this motor gave 2·45 H.P. on the brake; this shows a commercial efficiency of 73·3 per cent., and the efficiency calculated from the E.M.F. taken at the terminals of the machine when running is as high as 89 per cent. According to the nearest experiment without a load, at 1,232 revolutions, only ·112 H.P. was absorbed, or 4·73 per cent. of the brake H.P., at nearly the same speed, therefore, this mode of comparison cannot be applied.

When high speeds can be employed it is more economical to use a high E.M.F. with comparatively small currents, but in cases where the speed has to be reduced by gearing, the advantages of small currents may be more than counterbalanced by the disadvantage of mechanical friction.

Marine engineers, who are accustomed to experimenting with screw propellers, will find the electromotor and secondary battery the most convenient form of motive power in research work. With three simple instruments—the ammeter, voltmeter, and speed counter, every condition can be determined in an instant, and with the greatest precision.

Thus far we have dealt with the results of the launch *Electricity*, as originally designed, and it remains only to be mentioned that the D3 Siemens' machine stands 10 inches high, its length over all is 28 inches, and its width 23 inches. Each machine weighs 316 lbs.; the countershaft supports and pullies 180 lbs. Each cell ways 56 lbs., and is capable of furnishing 350 ampère hours, at a fairly constant current for 7½ hours, at the rate required by this boat. A cell is made up of 40 plates of lead, each 7½ inches long by 5¼ inches wide, placed vertically into an ebonite box. These plates are separated from each other by narrow india-rubber strips, and the box is filled with dilute sulphuric acid. Each plate weighing 18 ounces is capable of holding 8·75 ampère hours, and the whole box with 40 plates represents an energy of 1,858,000 foot-pounds, allowing two volts per cell.

One pound weight of battery power, including the lead, acid, receptacle and fittings will yield 33,000 foot-pounds, or one H.P. per minute. Having succeeded in our primary object, viz.: to prove that we could store and carry in accumulators sufficient energy to propel a boat, it became a question of reducing the weight and space of the machinery by abandoning the speed-reducing gear altogether. To this end the two motors were replaced by a single D2 Siemens' machine, fitted with reversing gear, and weighing altogether 658 lbs., whereas the former arrangement weighed 812 lbs.

This machine is very powerful as will be seen by the accompanying table (III.) of tests. We only required 4 H.P. with a maximum of 50 cells in series. In this case the dynamo spindle was coupled direct to the screw shaft, which arrangement allowed of increased room for passengers by reason of the absence of the countershaft and belts, so that the whole space occupied by the motor was only 30 inches in length, 28 inches in width, and 15 inches above the floor, the box which covered the machine forming a seat for passengers.

A special propeller had to be constructed for this purpose on the same lines as the original screw but with a finer pitch, and the following experiments were made with a view of ascertaining the most economical dimensions of blades for high velocities. The object of reducing the blades was to obtain a higher speed of shaft, with the same E.M.F., and less current:—

TABLE III.

D2 SIEMENS' MOTOR. RES. ·36 OHM.

E.M.F.		Revolutions per Minute.	Current in Ampères.	Brake H.P.
Battery.	Motors.			
78·4	68·6	540	42·9	2·7
,,	69·8	754	34	2·3
95·5	85·7	720	42·9	3·6
,,	88	870	37·1	3·5
,,	88·5	1150	29·7	2·9
117·6	105·4	880	44·5	4·4
,,	107·8	1200	37·1	4·8
137·2	122·5	1130	47·8	6·8
139·6	125·0	1200	42·9	6·0

First Experiment.

Diameter of screw, 19⅞ inches; mean pitch, 12·9 inches; expanded blade area, 103 square inches; with 45 cells in circuit the motor took a current of 57·2 ampères, whilst the screw made 630 revolutions.

Second Experiment.

Diameter of screw, 18¾; mean pitch, 12½; expanded blade area, 82; the same cells, 46 amperès at 748 revolutions.

Third Experiment.

Diameter of screw reduced to 17¾ inches; the pitch 11½ inches, and the expanded blade area to 66 square inches; with 46 cells in circuit the motor consumed only 43 ampères, and the propeller speed rose to 840 revolutions per minute.

As the blades were reduced by merely chipping and filing, they assumed a rather irregular shape and the speed of the boat itself did not rise as fast as the number of revolutions would warrant. But, since writing the above, I have succeeded in obtaining excellent results with a new screw propeller, the one you see before you on this table, and which was designed by Messrs. Yarrow. With this screw the speed of the boat was actually as great as the rate caculated from the pitch; there was no slip. The dimensions of this propeller (two blades of forged steel) are 18½ inches diameter, 11 inches pitch, and 90 square inches expanded blade area; number of revolutions 813; current 46 ampères with 46 cells.

This experiment having been performed so very recently, I have not had an opportunity to investigate the phenomena; but it may be reasonable to assume, that the finer the pitch of a propeller, and the greater its velocity under water, the nearer we approach the conditions of a screw passing through a solid substance.

The second launch of which I spoke was made by Messrs. Yarrow & Co., of Poplar, in conjunction with the Electrical Power Storage Company, and this craft is now at the Vienna Exhibition. She is 40 feet long with 6 feet beam, and can carry 40 passengers quite easily, for the whole of the machinery and secondary cells are conveniently disposed under the floor as ballast. The motor in this case is a D 2 Siemens' dynamo, which developes nearly 7 H.P. with 80 cells and a current of about 40 ampères. No gearing is used, and the spindle of the motor is coupled directly upon the propeller shaft. The screw is two-bladed, of thin forged steel, and was designed by Messrs. Yarrow; its diameter is 19 inches, pitch 13 inches, making 780 revolutions per minute, with 60 cells and 41·22 ampères of current at a speed of 8 miles per hour. Forty ampères is a very economical rate of discharge for these small cells, but where great power is required for a short time they can yield 60 to 80 ampères and the same weight of accumulators can furnish double the power, but for less than half the time. In this manner very high speeds may be obtained with but a moderate weight, and this is a most important desideratum in the propulsion of small vessels. With a weight of 126 lbs., representing 21 small cells, a current of 20 ampères through 42 volts has been attained for one hour, leaving a considerable charge available at a lower rate; and in cases where an intermittent discharge is convenient, still higher rates of current are admissible, since the cells recover themselves after short intervals of rest. The fact that the propeller may be coupled directly to the armature spindle of the motor has rendered this method of electrical propulsion peculiarly adaptable to many cases where, as an auxiliary or primary power, steam is not available, because the boiler, stoke-hole and engines must necessarily take up the best part of the vessel; but with this method, since all the machinery and cells are bestowed under the floor and not necessarily all together, the boat may be trimmed to any desired line of flotation and, the weight being constant, the draught will remain so, while the room for cargo or passengers is practically that of a sailing boat. The scores of small steam launches for harbour-masters, police, &c., may be advantageously replaced by electric boats. The work done by the propeller in the water will, in any case, be at least one half of the work expended by the steam-engine or water or other power near the shore used for charging the cells; so, from an economical point of view, an electrically-propelled launch will not cost more than a steam-launch, since the consumption of fuel in launch engines is considerable. A steam-boat will carry us further than an electric-boat, because coals can be had anywhere; the distances for electric launches will be limited until stations are established where the cells can be recharged after every 50 or 60 miles run.

A steam launch requires two attendants, one to attend to the engine and boiler and the other to the steering. In an electric launch, the man who steers can also start, stop, reverse or regulate the speed, for these operations are all effected, by the mere turning of two small handles, as easily as one would turn on or off or lower the gas in a room; in this respect there would be an appreciable saving in wages. There is no fear of an explosion in an electric launch, thus there is no danger of a serious shock; the internal resistance of 100 cells is only ·5 ohms. An electric launch, 40 feet long, will carry as many passengers as a steam launch of 51 feet length; and finally, there is the total absence of smoke, dirt, smell, noise and heat, points of great importance in pleasure boats as well as in vessels of warfare.

By Mr. J. CLARK.

The following description of an electric launch recently invented and patented by Mr. Allen Clark, of Glasgow, may be of some interest at the present time, though, as the experiments on the Clyde with this boat are not quite completed, only a general outline of the same can be given:—

The launch is a wooden boat, clencher built, 21 feet long by 4 feet 4 inches beam, and draught of water aft 12 inches, with three or four persons on board. She is fitted with an electric motor placed under the stern sheet, and entirely out of the way, the armature of which is coupled to the propeller shaft, and, therefore, drives the propeller direct, without the necessity of any gearing whatever. In the middle of the boat are two oblong mahogany boxes, 3 feet long by 8 inches broad, and 12 inches high, which contain the battery cells, and these boxes can be used as a seat when the boat is run. The electricity generated in the batteries is led to the motor by two wires, and the batteries require re-charging about every four hours of continuous use, which can be done in a few minutes—one battery driving the boat at three-quarter speed, while the other is being charged. During several trials of the boat at Kilcreggan, on the Clyde, a speed of a little over five miles per hour was obtained, the motor running steadily at 600 revolutions per minute. The weight of the boat complete, with batteries charged, is some 4 cwt., and can be transformed in a few minutes into an ordinary rowing boat by removing batteries, motor, and propeller. The advantages claimed by this form of launch are—absence of noise, smell, of smoke, and dirt, freedom from vibration, greater stability, and more space available for passengers. The electric motor will start, stop, or reverse instantly without shock, and has no wearing parts. Clark's electric launches are now being built by Messrs. Gilbert, Boyle & Co., Glasgow, of various sizes, from 15 feet long and four miles per hour speed, to 30 feet long, with seven miles per hour speed, and are specially adapted for being carried on yachts' davits, their weight being only one-third of a steam launch of a similar size. An electric port, starboard, and mast-head light can be carried and worked off the same battery that supplies the motive power.

Admiral Sir ERASMUS OMMANNEY, C.B., F.R.S., said he had listened to the papers with great satisfaction, and gave it as his opinion that electric launches would ere long be brought into general use.

Sir WM. SIEMENS thought the facts given in Mr. Reckenzaun's paper could be fully substantiated. There were, of course, many applications of electricity which would admit of large extension, and, again, electricity might be applied to many more purposes than it was at present, but some of these he thought would be evident mistakes—as, for instance, to work a bicycle or tricycle by it, as such carriages, with electric dynamo machines and batteries, would undoubtedly become too heavy to be useful. The case was, however, wholly different with regard to steam launches. There they had a case where steam power could be applied only at a great disadvantage. The launch engine was necessarily very cramped, the boiler unsatisfactory for sea water, and time was lost in getting up steam. All these disadvantages were met by the application of separate batteries and dynamo machines, and he might say from his own personal knowledge of the behaviour of those electric launches, that they promised very excellent results. The main question was, what was the secondary battery going to do? Was it going to last, or was it to be perishable? In order to test this question he had put down secondary batteries in his own house last autumn, and charged them by means of a very small gas engine—¼ H.P.—and the result so far had been very satisfactory. He had lighted his house by this small engine, with the aid of the secondary battery, using 40 incandescent lamps, with great effect, sometimes from seven o'clock or half-past seven o'clock in the evening till one or two o'clock next morning. In the case of an electric launch, they could not take their machine with them; the very object was to be without it, and they had to stop occasionally to get their batteries re-charged. He would therefore limit the application of electric power to navigation to short stages of, say, seven or eight hours' duration, but not days. For such passages the advantages of the steam launch would be many. The section ought to be obliged to Mr. Reckenzaun for so ably bringing forward the subject.

Sir JAMES DOUGLAS was of opinion that there was no doubt but this system of the electric launch must be at once very considerably extended to and in all parts of the world.

Monday, September 24th.

ELECTRIC TRAMWAYS.

By W. M. HOLYROD SMITH.

The proposal to lay tramways in Halifax excited my attention as an engineer, and as our town presents unusual difficulties owing to the narrow, tortuous, and steep streets it became necessary to consider the best means of coping with them. Horse traffic was *prima facie* out of the question, owing to the cost of horse flesh and cruelty to animals. Steam was questionable—first, on account of the growing public objection thereto; and secondly, the danger incident to running heavy engines up and down steep gradients in crowded streets. The cable system, though an admirable one in its way, and calculated to overcome the natural obstacles of a hilly district, seems in my opinion inapplicable, owing to the enormous outlay it would involve, many of our roadways being of solid rock, the great cost of working, and the small traffic to be expected. Pneumatic engines being open to objections similar to steam, my thoughts naturally turned to electricity. Such rapid strides have been made of late in the development of this wonderful agency that it has now arrived at that state when it may be considered amongst the numerous facts and forces at

the disposal of the engineer. In endeavouring to make electricity practically applicable for the purpose named, I started with the following propositions:—1st, safety to the public; 2nd, protection of the electric force; 3rd, tractive efficiency. It is, perhaps, hardly necessary to remark that wherever the conductors are exposed, whether as rails or side bars, liability to accident exists, and further, that not only is there a loss by leakage through the earth, but the line is also subject to be short circuited accidentally. The system advocated by Professors Ayrton and Perry, though probably admirable from an electrician's point of view, seems to me to be wanting in practicability, and open to minor defects. Without discussing the systems already tried, it is perhaps sufficient to say that the propositions laid down seemed to me to have their solution by the simple expedient of employing a central channel to contain the wires or bands conveying the electric force and effecting the haulage by means of a large wheel, with a broad face, running upon the surface of that channel. After carefully working out designs and making such calculations as lack of data permitted me to do, I proceeded to make experiments for the purpose of testing my theories. First, as to the comparative efficiency of the large wheel and small ones, I laid a short length of rails in a warehouse with a flag stone floor, guage 2 ft. 9 in., and constructed a rough truck with two small wheels and one large central one. The large wheel was 3 ft. 0 in. diameter, 6 in. wide, and the two small ones were each 12 in. diameter and 1¼ in. wide. The truck weighed exactly half a ton, and was so proportioned that 5 cwt. came upon the large wheel and 5 cwt. upon the small wheels; both axles are fitted with gear, so that either could be moved. To the end of the car a rope was tied, and passed under a pulley fixed to the ground, and thence over a pulley hung from a beam above, to the end of this rope weights were applied, and the small wheels made to revolve, the truck, moving forward, drew the rope and lifted the weights. The load was gradually increased until it reached 1 cwt., when the wheels began to slip at 1 cwt. and 14 lbs., they simply revolved round and round and would lift no more. Motion was then transferred to the large wheel, and the weights again applied until the load reached 3 cwt. 3 qrs., when the tackle gave way, there being not the slightest slip. I considered this result sufficiently satisfactory to make it unnecessary to renew the tackle. My next experiment was also a rough one to test the possibility of collecting the electricity from the central channel and converting it into dynamic force to drive the large wheel. I therefore laid a line 50 yards long, 3 ft. gauge, and placed upon it a rough truck. The track was simply made of rough planks, and was laid in the grounds of Moorside, the residence of Mr. L. J. Crossley, who kindly placed at my disposal his electrical apparatus, and permitted me the use of his admirably fitted workshop. Copper bands, similar to those used for lightning conductors, were laid within the channel, and upon them ran a wooden trolly, part of which I now show you. Connection was made between the trolly and the truck by means of a box or frame shutting upon it; the box used being here for examination. The car and gearing were of a rudimentary character, the main wheel was 4 feet diameter, 7 inches wide. The electric motor employed in the first instance was one of Siemens' medium dynamos, but from some defect it would hardly revolve alone, though the electricity from a Gramme machine was conducted to it with little loss. I then took a Siemen's D 3 dynamo and modified the gear, and though this was far too small a motor for such a load—viz., one ton—the whole mass moved slowly up the gradient of 1 in 20. This experiment was sufficiently satisfactory to lead me to further efforts. I therefore laid a fresh line nearly 100 yards in length up the same walk, guage 18 inches, and made a fresh car. The same Siemens' D 3 machine was employed as before. The gear consists of a brass pinion upon the axis of the dynamo gearing into a wheel with wooden pegs in lieu of teeth. This wheel is free to revolve upon its shaft, and is fitted with a fractional clutch actuated by the two hand wheels, one on either side of the car. Upon the same shaft is keyed a pinion gearing with another wheel attached to and forming part of the main driving wheel, which is 2 feet diameter and 4 inches wide. The face of this driving wheel consists partly of wood and partly of a special material to ensure hold upon the central track. The brake is actuated by a treadle under the control of the driver's foot. The switch for connecting and disconnecting the electricity is attached to the dashboard in front. The track is constructed of planking. Transverse sleepers are laid upon the asphalt walk, and upon them rest four longitudinal spars, the middle ones forming the sides of the central channel, and with the two outer spars support the top boarding, which consists of cross planking so laid as to leave half-inch space over the centre of the mid channel. Every third board or covering plank is screwed down, and the rest are nailed; this was done to facilitate removal in case of mishap. The tramrails consist merely of 1¼-inch angle iron screwed to the surface of the planking. The conductors laid in this track consist of copper bands $\frac{3}{16} + \frac{5}{16}$; brass discs are soldered to them at intervals. These discs have small holes punched in them, and form a ready method of attaching the conducting bands to the bottom sleepers. The collecting trolly used is upon the table, and consists of two brass side frames insulated from each other by a block of wood. In each end of these fixings work guide or carrier wheels, and attached to the sides are cases containing slippers or skids free to rise and fall—this to insure contact in case of unevenness in the track or from vibration. Each brass frame has upon one end an upright plate or flat bar long enough and thin enough to pass through the slit in the top of the track. As the track in this instance consists of wood, it was not necessary to insulate these plates; the electricity, therefore, collected by their respective wheels and slippers is ready for connection with the motor on the car by means of insulated copper wires. This trolly is made to travel with the car by simply passing a wooden bar between the two upright plates, the bar being held in fixings attached to the side frames of the car. The entire weight of the car, with dynamo and gear, is 16 cwt. The track, as before stated, is on a gradient averaging 1 in 22. I do not propose to give you a tabulated list of ampères, volts, curves of results, &c. These matters are rendered sufficiently interesting by those who make them a speciality. It is, I assume, practical results that are most wished for, and I therefore content myself with saying that though it is as much as three men can do to push the empty car up this steep hill, yet the electricity was so collected and used as to run it up at a moderate speed with six adults in the car—total weight, say, 24 cwt. It may be argued that the demonstration made is simply an experiment, and that there are many details inapplicable to daily work. Such a statement I am prepared at once to admit—viz., the demonstration so far is an experiment, but a most successful one. And I now propose to show how some of the details may be modified for actual daily use on a large scale. In respect to the car itself perhaps enough has been said to show the principle involved and its practicability. As to the best electric motor to be used, that I admit is a debateable subject. Though not professing to be an electrician, I must confess that no electric motor that has yet come under my notice fulfils what I conceive to be possible, or is constructed in a way calculated to make the best use of known forces. Again, as to gear, though I took care to test by experiment the strength of the wooden pegs used in the wheels, and found them practically applicable and leaving sufficient margin of strength, and though their employment overcomes the objection of noise and forms a wheel easily repaired by an ordinary mechanic, yet, owing to the high speed at which electric motors must necessarily run, I hold it advisable to employ some form of compound differential frictional gear, and have, therefore, made experiments to that end; but they are not yet sufficiently advanced to bring before the notice of this society. Again, as to the surface of the traction wheel, I confine myself to the statement that it is of special material, experience alone must determine how far it is suitable for the wear and tear of every-day work; therefore, I refrain at present from giving a precise description. Respecting the track, though I have designed and patented many modifications thereof, it is perhaps sufficient to give a description of one, and this I have endeavoured to illustrate by a section of a tramway. There is the surface of the road; a transverse sleeper, upon which the rails rest; the ordinary tram rails, and the central channel, consisting of rolled or cast-iron girders of the form shown. At intervals, along the channel, are bolted brass chairs, on vulcanite blocks; these chairs are made to hold galvanized angle iron in the manner shown, and the same key that holds the angle iron also grips a copper wire, by this continuation a firm track is formed for the trolly, and the electrical resistance is minimised. I would also point out that copper wires might be used only for the leading conductor, return circuit being made by means of the metal of the channel itself; ribs or flanges could be rolled or cast upon them for the wheels of the trolly to run upon. From another sketch, showing on a smaller scale a longitudinal section of a line, it will be seen that sump-holes or wells connected with the street drains are placed at intervals to collect and carry away any water that may accumulate, and also to permit of the channel being occasionally flushed. Respecting the trolly upon the table, will be found a drawing illustrating one suitable for a full-sized line. The channel in which it would have to run being of iron, the upright plates are distinct from the side frames, and they have channels formed in them in which insulated copper bands attached respectively to each side frame are placed. The electricity can thus be gathered from the conductors, and passed to the car without short circuiting through the channel. To insure good contact with the conducting bands or rails, in addition to the guide wheels and in lieu of the slippers or skids, a number of wheels are placed down each side of the trolly. These wheels are free to rise and fall in their bearings, which are so attached to the frames that the axis of the wheels may be placed at any angle with the line of motion, thus causing frictional as well as rolling contact between the periphery of these wheels and the rails, the relation between the frictional and rolling contact being adjustable. I will not weary you with any further details, but take this opportunity of stating that with the assistance of those associated with me I am prepared to construct a full sized tram line in any public street, or to convert existing lines into electric lines in accordance with my system, and to guarantee success, and sincerely hope before the next annual meeting of this honourable Association to be able to report progress.

(To be continued.)

A Concession Wanted.—It is said that, apart from the inspection of the Eastern Telegraph Company's stations, Mr. John Pender, M.P., intends visiting Constantinople with the view of obtaining the Imperial firman for the concession of the telegraph cable now in use between Tenedos and Salonica. Some three years ago Mr. Pender *had* an interview with the Sultan, but then failed to get the concession; now, however, he is sanguine of success.

SPECIAL REPORT ON DYNAMO MACHINES AND ARRANGEMENTS FOR LIGHTING.

By DR. ST. DOUBRAVA.

I.—*The Flat Ring Machine.*

THIS machine, as commonly constructed, was first built by Schuckert, of Nurnberg. It consists of four electro-magnets (fig. 1), of which two and two have always

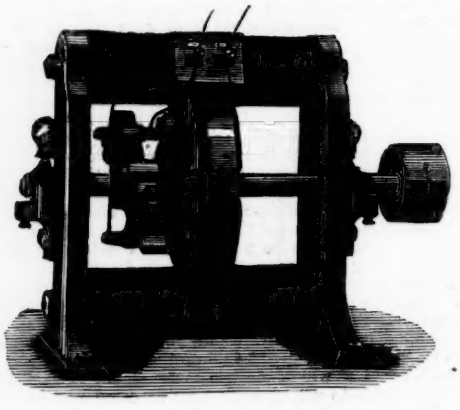


FIG. 1.

similar poles turned towards each other. The inductor consists of a flat annular core of iron, and is wrapped exactly in the same manner as that of Gramme. But though there is no difference in principle between Gramme's ring-inductor and the flat ring, the latter has certain advantages. In order the better to understand these we will enter into the consideration of this inductor in detail.

If N and S are two magnetic poles, the lines of force pass between these poles about as shown in fig. 2. To every point of the one pole there passes a line of force to the corresponding point of the second pole. Both the course and the distribution of the lines of force are changed if masses of soft iron are in the space. Soft iron has the property of, so to speak, compressing into itself the magnetic lines of force; in the space, therefore, which is occupied with masses of iron, the magnetic lines of force are compressed much more closely to each other than they are outside the iron. Fig. 3

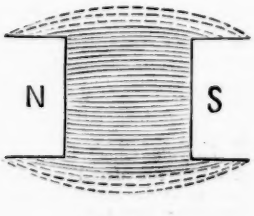


FIG. 2.

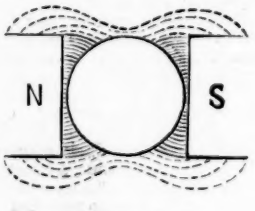


FIG. 3.

shows approximately the course of the lines of force if between the two magnetic poles, N and S, there is placed a circular plate of soft iron. The lines of force which in fig. 2 pass from one pole to the other, either parallel or in curves, appear in fig. 3, bent in the middle and forced into the plate.

If instead of a plate we take a ring, the course of the lines of force is approximately represented by fig. 4. Only a small number of the lines of force pass through the internal opening of the ring, which is, of course, free from iron.

A considerable number of the lines enter directly from one pole into the ring, and pass in it to the other pole.

Fig. 5 shows the entrance and exit of the lines of force. The drawing is made for a plane, which is laid vertically to the plane of the ring, and contains in itself the line connecting the two magnetic poles. We see how the lines of force enter the ring from the one pole and take their exit on the other. The portion which passes through the ring is omitted.

A third set of lines of force is compressed into the ring from the sides in a similar manner as in the iron disc.

If the ring is folded round with wire, so that the whole coil is continuous, we have then, as is well known, the *Pacinotti-Gramme* ring-inductor. If the ring is turned on an axis, which passes through its centre vertically to the plane of the ring, there are produced currents in the single coils of wire as the magnetic lines of force are cut in the rotation.

We will consider the origin of the currents a little more closely.

That part of the lines of force which enters the ring above and below is useless in practice (fig. 4). Each line of force cuts here each coil of the wire twice; it

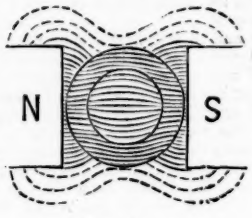


FIG. 4.

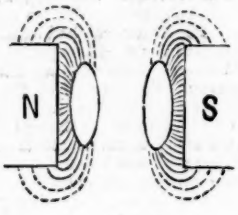


FIG. 5.

enters the coil on one side and issues at the opposite. If the ring is made to rotate there arises at the spot where the line of force enters, an electromotive force which produces a current in a certain direction. At the spot where it issues there arises also an electromotive force, occasioning a current in the opposite direction. These two currents mutually annul each other. For the production of a current there remain effective only those lines of force which traverse the protuberance at its outer surface.

The lines of force which traverse the mass of the soft iron intersect the coils of wire at the outer surface only, and chiefly avoid the inner surface. They therefore produce when rotating a current in a certain direction. (See the section, fig. 5.)

These lines of force change their direction on the revolution of the ring. Pfaundler has made a direct and permanent representation of the lines by means of iron filings, and his very fine figures are exhibited (catalogue No. 271). Prof. Mach (catalogue No. 270) and Ph. Hanck (catalogue No. 348) exhibit similar figures.

In order to explain more fully the origin of the currents we will retain the quite conventional expression that the magnetic lines of force enter the ring near the north pole and issue near the south pole, and fix our attention on a coil of wire which passes the north pole. The lines of force enter the coil here, and there arises consequently a current in a certain direction. It is strongest in the immediate neighbourhood of the pole, since almost all the lines of force are intersected perpendicularly by the coil; the more we remove from the pole the coil intersects the lines of force at more oblique angles. The current becomes feebler and feebler until at last it becomes = 0 at the place where the coil runs parallel to the lines of force. The place where this occurs is called the neutral point; in fig. 4 both points are perceptible. In consequence of the distortion of the lines of force due to rotation the neutral points are often considerably displaced.

If the coil is moved past the neutral point towards the south pole there arises a current in the opposite direction. It becomes stronger and stronger until it reaches its maximum in the neighbourhood of the south pole. From thence it grows gradually feebler up to the second neutral point, then it = 0.

If a plane is carried through the two neutral points, and perpendicular to the plane of the ring, it divides the ring into two perfectly equal parts. In the coils of the one part there arise currents in a certain

direction, and in those of the second part currents in the opposite direction ; the currents in the coils of each part unite together to a single current in consequence of the conductive connection. The two currents meet at the neutral points, and as they are opposite in direction they annul each other. But if sliding contacts are applied at the neutral points, and connected together, the two currents unite in the well known manner to form a single current. The work which is converted into a current by the inductor can be applied in the most varied manners by conducting the current away. A part of the current is, however, always lost in the inductor. The current has to pass through all the coils of the inductor, and has to overcome a certain resistance, in consequence of which it is partially converted into heat. This conversion is the more extensive, the more electromotorically inactive matter the inductor contains.

As appears from fig. 6, the whole internal length of wire, as it is not traversed by any electromotively active line of force is merely conductive ballast in which electric energy is transformed into heat. The practician cannot utilise this heat in any manner, but finds it in most cases an inconvenience. Hence he can consider it merely as wasted energy. It is clear that this loss is the smaller, the shorter, other things being equal, is the length of the inactive material. If we conceive for this purpose the two poles of the ordinary Gramme inductor, intersected so by a plane, and the two halves so bent as to produce fig. 6, it will then represent a flat ring machine in section. The parts between *a*, *b*, and *c*, *d*, are electromotively active. Their length and the traversing number of lines of force has remained substantially the same as formerly. By this arrangement no electromotively active material has been won, but *something inactive has been lost.* Here is one of the chief advantages of the flat ring machines, that the part which is electromotively active, *a*, *b*, and *c*, *d*, can be made considerably longer than the inactive part, *a*, *c*, and *b*, *d*. Circumstances being otherwise equal, there is less electrical energy converted into heat in the inductor of a flat-ring machine than in a Gramme inductor. A further advantage of the flat-ring machine is that the inductor has a relatively

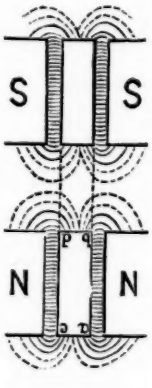


FIG. 6

greater diameter. The consequence is that it requires to make fewer revolutions in order to give the conductors at its circumference the same absolute speed as an inductor of smaller diameter.

From the same reason the supports of the machine are not worn out so rapidly, and it is not so much heated as is the case with the majority of other machines

The flat-ring machines are strongly represented at the exhibition. Besides Schuckert, Piette and Krizik of Pilsen, and Werndt of the Styrian manufactory of arms, have large displays of plant.

Krizik's arrangement consists of several dynamos for divided lights, single, and incandescence lights. The most noteworthy objects are the large dynamos for divided lights, each feeding 12 Krizik lamps arranged in series, each of which is said to give the light of 1200 normal candles. The machine makes 620 revolutions per minute, has the tension of 600 volts, gives a current of 8 ampères, and consumes 8 effective horse power. A further notable machine in this installation is a compound dynamo. It is arranged for 50 Edison lamps, of 16 candle-power each, but it can be used for a combined transfer of power. The machine makes 870 revolutions per minute and consumes 8 horse-power.

The installation of Werndt includes, besides some machines for single and divided lights, and for depositing nickel, an interesting transfer of power. A smaller dynamo is combined with a compound machine. The armature wire is 20 metres long, and consists of copper wire 6 millimetres in diameter. The machine evolves 2 horse-power, and is used to drive a universal machine employed for hollowing out the stocks of rifles to receive the locks. When set in action it attracts a a crowd of spectators, it being really a novelty to see small arms manufactured by Electricity.—*Internat. Zeit. für die Elek. Ausstellung in Wien.*

THE ELECTRICAL TRANSMISSION OF POWER.

NOTE BY M. BOULANGER IN THE NAME OF THE COMMITTEE APPOINTED BY THE TOWN OF GRENOBLE TO WATCH THE EXPERIMENTS OF M. MARCEL DEPREZ.*

THE importance of the question of the transmission of power by electricity need not now be dwelt upon ; the experiments made last March in the workshops of the Northern Railway, have shown us what results it is possible to obtain. The remarkable report written upon these experiments proved the superiority of these results over any before obtained, and, at the same time, showed the agreement existing between theory and practice.

Therefore, in the experiments made at Grenoble, the committee appointed to take part in them thought it best to make it their chief aim to obtain a great number of observations, and to make these observations principally on the dynamometrical measurements. The results of these measurements form the subject of the present note.

Electrical measurements were, however, also taken ; they served to verify more completely the experiments as a whole, and to justify the employment of the methods adopted. The machines employed were the same as at the Northern Railway ;† but the wire of the inductors of the receiver had been changed, the insulation of the different parts had been improved, and, finally, the two machines were insulated from the earth by means of frameworks of dry wood.

The receiver being at Grenoble, the generator had been installed at the works of Messrs. Damaye and Compagnie, near the station of Vizille, where it was worked by a turbine. The two machines were at a distance of 14 kilometres from each other ; they were connected by two wires of silicious bronze, two millimetres in diameter. The resistance of this line was 167 ohms. As to the machines, their resistance, measured several times, was found to be—

		Ohms.	Ohms.
Generator .	Inductors . . .	20·10	
	Armatures 2 × 18·30 =	36·60	R = 56·7
Receiver .	Inductors . . .	61·00	
	Armatures . . .	36·00	r = 97·00

* Members of the committee appointed by the Mayor of Grenoble :—M. Boulanger, captain of engineers, *President and Chairman* ; M. Labatut, teacher of physics at the Faculté des Sciences, *Secretary* ; M. Jordan, civil engineer, M. Kuss, engineer of mines ; M. Merceron, engineer of roads and bridges, M. Rivoire, engineer of roads and bridges, M. Pérémé, inspecting engineer of telegraph lines, *Members* ; M. Viallet, civil engineer, M. Charlon, civil engineer, M. Perrin, Director of the Ecole Professionelle, M. Peyrard, civil engineer, *Additional Members.*

† Already fully described by us.—EDS. ELEC. REV.

The only instruments at the disposal of the committee for mechanical measurements were Prony brakes; the consequence was, that in order to measure the work absorbed by the generator, it was necessary to have recourse to the method of substitution. The numerous verifications made in the course of the experiments fully justified the employment of this method, which, besides, has the great advantage of being practically more convenient than any other.

The turbine worked, by means of gearing a driving shaft; the latter transmitted the motion to the generator through counter-shafting, which had to be employed in order to obtain the requisite speed. On this driving-shaft the brake was placed, mounted on a pulley about 0·60 metres in diameter. This brake had been put in equilibrium when not loaded; its lever arm was 2·50 metres in length. Its temperature was maintained constant by the continuous flow of a mixture of soapsuds and olive oil. The sensibility of the apparatus was, besides, pretty evident, since the brake being loaded with 54 kilogrammes, the addition of a weight of 50 grammes was sufficient to upset equilibrium. The maximum work of the turbine working under the best conditions of speed, measured by means of this apparatus, was found to be equal to 27 H.P.

Calling P the load of the brake, N the number of revolutions per minute, and L the length of the arm of the lever, the work is expressed by the following formula:—

$$\tau = \frac{2\,\pi\,L\,N_0\,P}{4500} = 0{\cdot}00349\;N_0\,P.$$

At Grenoble, the work received was measured by a brake of smaller dimensions, mounted on the pulley of the receiver. The arm of the lever being 0·815, the formula was $\tau_u = 0{\cdot}001138\;n\,p$.

They then proceeded as follows:—

The turbine was started with the generator out of gear, *i.e.*, turning only the loose pulley of the counter-shafting. The brake at Vizille was then put in equilibrium with a load, P, and N_0 was counted. A weight, p, was then placed on the Grenoble brake and the generator was put in gear. The equilibrium was destroyed: it was restored at Vizille, so as to reproduce exactly the speed, N_0, of the axle of the brake, which was obtained within about one revolution. The load at Vizille became P^1, and, when equilibrium was restored, the indications of the two brakes were observed simultaneously.

With these conditions, it is evident that the work expended by the generator and the counter-shaft, or the gross motive work, is expressed by the formula:—

$$\tau_b = 0{\cdot}00349\;(P - P').$$

In this equation it is taken for granted that the total energy furnished by the turbine does not vary during the experiment. In order to insure that this last condition was fulfilled, after each series of experiments, *i.e.*, before modifying the speed of the turbine, the brake was unloaded again, the generator being at rest, and it was found that each time, for the same load, the axle of the brake regained exactly the same speed.

Table I. gives the result of the experiments.* The motive work τ_m, which served to calculate the rendering, is equal to the gross motive work, minus the loss due to the friction of the countershaft on its bearings. This loss, taking into account the weight of the countershaft and the tension of the belts, is equal to $0{\cdot}00227\;N_0$. The slipping of the belts should also be taken into account, but the comparison of the speeds of the generator, calculated and measured, shows that these slips are of slight importance.

The figures contained in table I., show that the maximum rendering amounted to 62 per cent. in transmitting nearly 7 H.P.

* The manuscript table sent by M. Boulanger to the Academy contains, beside the results of the experiments of Sept. 1st., the results of other preliminary experiments, performed Aug. 22nd and 23rd.

TABLE I.—*1st September*, 1883.

Number of the Experiments.	VIZILLE. Revolutions per minute of brake axle N_0.	Revolutions per minute of generator. Calculated N_1.	Revolutions per minute of generator. Measured N.	Loads on brake. Generator at rest. P.	Loads on brake. Generator in action. P′.	Motive work. Total work on brake axle $0{\cdot}00349\;N_0P = T_0$.	Motive work. Gross $0{\cdot}00349\;N_0(P-P') = T_b$.	Motive work. Transmission deduced. T_m.	GRENOBLE. Revolutions per minute—Receiver. n.	Loads on brake. p.	Work received $0{\cdot}001138\;np = T_u$.	Rendering $100 \times \frac{T_u}{T_m}$.
				kg	kg	h.p.	h.p.	h.p.		kg	h.p.	
H 1..	110	730	720	54·00	35·20	20·73	7·22	6·97	484	6	3·30	47·3
H 2..	110	730	730	54·00	32·00	20·73	8·45	8·20	446	7	3·55	43·2
H 3..	110	730	732	54·00	30·00	20·73	9·21	8·96	406	8	3·69	41·1
K 1..	130	870	865	40·50	21·50	18·37	8·62	8·33	614	6	4·19	50·3
K 2..	130	870	865	40·50	18·20	18·37	10·11	9·82	586	7	4·66	47·4
K 3..	130	870	875	40·50	15·50	18·37	11·34	11·05	558	8	5·08	45·9
L 1..	145	961	946	45·00	27·70	22·77	8·75	8·42	712	6	4·86	57·7
L 2..	145	961	954	45·00	24·20	22·77	10·43	10·10	686	7	5·46	54·0
L 3..	145	961	970	45·00	21·70	22·77	11·79	11·46	662	8	6·02	52·5
M 1..	160	1061	1040	35·00	17·00	19·54	10·05	9·69	830	6	5·66	58·3
M 2..	160	1061	1040	35·00	14·50	19·54	11·44	11·08	778	7	6·19	55·8
M 3..	160	1061	1050	35·00	12·10	19·54	12·69	12·33	734	8	6·68	54·1
N : 1..	170	1127	1140	28·50	9·00	16·90	11·56	11·18	875	7	6·97	62·3

We may, however, make a few remarks on these figures, showing the perfect agreement between the results obtained and theory, and which will, consequently, serve to demonstrate the accuracy of the measurements taken and of the methods adopted in order to obtain them.

We may observe, in the first place, that when we attain the speeds obtained in the experiments, the magnetic fields of the machines are near their saturation points and cease to be functions of the intensity of the current. The electrical measurements, containing nearly 50 observations, showed, besides, that the losses from the line might be disregarded, and that the intensity might be considered as uniform. If this is the case we should get, as M. Marcel Deprez has shown, calling this intensity I:

$$p = K\,I \text{ and } P - P' = K'\,I.$$

K and K′ being two constant coefficients.

From these two equations we get—

$$\frac{P - P'}{p} = \frac{K'}{K} = \text{const.}$$

Table II., drawn up for these same experiments of Sept. 1st., shows that this relation is constantly verified.

TABLE II.

Number of the experiments.	Values of p.	Values of P.	Values of P′.	Values of P—P′.	Values of $\frac{P-P'}{p}$.	Observations.
	kg	kg	kg	kg	kg	
H 1...	6	54·00	35·20	18·8	3·13	The mean of the values of $\frac{P-P'}{p}$ may be taken as equal to 3.
H 2...	7	54·00	32·00	22·0	3·14	
H 3...	8	54·00	30·00	24·0	3·00	
K 1...	6	40·50	21·50	19·0	3·16	
K 2...	7	40·50	18·20	21·3	3·04	
K 3...	8	40·50	15·50	25·0	3·12	
L 1...	6	45·00	27·70	17·3	2·88	
L 2...	7	45·00	24·20	20·8	2·97	
L 3...	8	45·00	21·70	23·3	2·91	
M 1...	6	35·00	17·00	18·0	3·00	
M 2...	7	35·00	14·50	20·5	2·92	
M 3...	8	35·00	12·10	22·9	2·86	
N : 1...	7	28·50	9·00	19·5	2·78	

From this remark we deduce a convenient method of calculating the rendering. In fact, in Table I., the rendering was calculated by the formula—

$$100 \times \frac{\tau_u}{\tau_m} = \frac{0{\cdot}001138 \times n\,p}{0{\cdot}00349\;N_0\,(P - P')}$$

or, replacing the speed of the driving-shaft by that of the generator—

$$100\,\frac{\tau_u}{\tau_m} = \frac{0{\cdot}001138 \times 6{\cdot}63 \times n\,p}{0{\cdot}00349 \times N\,(P - P')}$$

or, finally, taking—

$$\frac{p}{P - P'} = \frac{1}{3}$$

as is indicated in Table II.,

$$100 \times \frac{\tau_u}{\tau_m} = \frac{n}{N} \times 0{\cdot}72$$

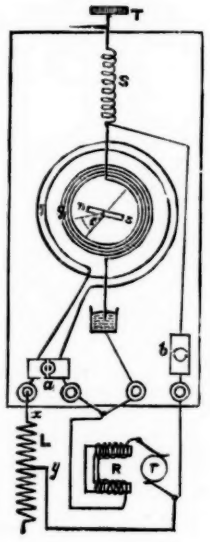
a relation in accordance with the indications of Table I.

These remarks are important, as they show that the results foreseen by theory have been verified by the Grenoble experiments, and they also show the confidence that can be placed in the measurements taken by the committee.

A COMBINATION GALVANOMETER AND DYNAMOMETER.

WHEN a "potential" galvanometer, g_1, connects two points, x and y, between which there is inserted a "current" galvanometer, g, and a resistance, L, then, if the potential galvanometer is graduated in volts and the current galvanometer in ampères, the product of their deflections, V, A, will give the electrical work performed in the circuit, L; or their dividend $\frac{V}{A}$ give the resistance, L.

It is well known that when a dynamo performs its maximum work in a circuit, L, that the resistance of its armature, r, is equal to the exterior resistance, L; if, therefore, the resistance, L, is varied until the product of the deflections of the potential and current



galvanometers becomes a maximum, then the work performed in the circuit, L, which equals V, A, will be a maximum and $\frac{V}{A} = L = r$; so that by these means the resistance of the armature of a dynamo may be measured while the machine is running. But as it would be more convenient to measure the product V, A, by a dynamometer than by two galvanometers, the following instrument has suggested itself to me. It consists of a dynamometer, potential galvanometer and current galvanometer combined. The instrument, illustrated by the figure, consists of—

Firstly, an outside coil, g (fixed), of thick wire, which produces upon a needle, n, s, a unit deflection with an ampère current; and, secondly, a fine wire coil, g_1, which may be either fixed in the same plane as the thick wire coil, when it produces a unit deflection with a difference of potential of one volt at its terminals; or it may be suspended at right angles to the thick wire coil, then the two coils act as a dynamometer, and the product of the two currents is measured by the angle through which the screw, T (regulating the tension of the spring, S), is turned in bringing the coil to zero.

When using the dynamometer, a plug would be inserted at b only, but when measuring the current or potential, only the two coils would be fixed in the same plane, and both plugs, a and b, inserted to read the potential, or both plugs out to read the current strength.

With this instrument it is also possible to measure the resistance, L, by the tangent of the deflection of the needle, when the coil, g_1, is fixed at right angles to the coil, g. For then the action of the current through g on the needle is $\frac{V}{L}$ sin. $\theta°$, and the action of the current through g_1 on the needle is V cos. $\theta°$, therefore—

$$\frac{\text{action of current through } g}{\text{action of current through } g_1} = \frac{\frac{V}{L} \sin \theta°}{V \cos. \theta°} = 1 = \frac{\tan. \theta°}{L}$$

$$\text{therefore } L = \tan. \theta°.$$

It would, of course, be necessary in this case to neutralise the magnetic directive force of the earth by placing a magnet near the instrument.

I believe an instrument with two coils fixed at right angles to each other for measuring the resistance of a circuit, in a manner somewhat similar to the above, has been patented by Profs. Ayrton and Perry.

W. MOON.

[Mr. Moon's suggestion that the resistance of the armature of a dynamo might be measured by making V A a maximum, would not, we fear, give reliable results in practise, as although the resistance of the armature should equal the external resistance to give the *absolute* maximum, yet an economical maximum would be attained when the resistance of the armature and the external resistance differ considerably.—EDS. ELEC. REV.]

NOTES.

To our Readers.—In response to our last week's appeal on behalf of the distressed widow and family of the late R. Werdermann, a few—very few—generous friends have sent us their donations. Lest there be any who may not have seen the above-mentioned notice, we beg to intimate that cheques and postal orders will still be thankfully received for this fund by H. Alabaster, Gatehouse & Co. (to whom remittances may be made payable), addressed ELECTRICAL REVIEW office, 22, Paternoster Row.

Errata.—In Professor Ewing's B. A. paper on "The Magnetic Susceptibility and Retentiveness of Iron and Steel," published in our columns last week, in column 1, line 6 from bottom, for "1,500" read 15,000; column 2, line 29 from top, for "K" read κ; line 32 from top, for "co-efficiency" read coefficient; line 44 from top, for "exchanging" read changing; line 45 from top, for "I = 1,240" read I = − 1,240; line 58 from top, for "strength" read stress; line 59 from top, for "pressure" read presence.

Electric Lighting.—By the aid of the electric light the new bridge of the London, Chatham and Dover Railway, at Blackfriars, is being pushed on during the night as well as day, and great progress is being made with the undertaking.

Times are, says a financial contemporary, very slowly drifting towards the period when electric lighting will pass from the experimental to the practical stage. The announcement that Mr. Shaw-Lefevre has purchased from the Edison Electric Light Company the plant used in connection with recent experiments in the House of Commons is, we think, a rather significant occurrence. Whatever Mr. Shaw-Lefevre does with the machinery

and apparatus which he has thus acquired will assume from his official connections an importance which an ordinary person could not expect to achieve. We are not without hope, therefore, that under Mr. Shaw-Lefevre's private experiments some definite conclusion will be proved that may tend to popularise electric lighting as a public and domestic necessity. In the meantime, we regret to notice that the difficulties which local authorities have thrown in the way of the new light do not seem to diminish. The City Corporation—a body which might reasonably be supposed to set a bright example in this respect—have received the report of the special committee which was relegated to inquire into the merits of the electric light question, but beyond deciding to spend a paltry £200 to settle the question of which is the best incandescent light have done nothing. The Gülcher, Maxim-Weston, Metropolitan Brush, Pilsen-Joel, and the Telegraph Construction Companies are accordingly to be asked to send in new tenders for lighting a small portion of the city.

Arrangements have now been completed whereby the Victoria Hall will be illuminated by the electric light during the approaching musical festival. It is proposed to have about 400 incandescent lights. In addition to the gain in illuminating power, the comfort of the audience will be greatly increased.

It must be "gall and wormwood" to the shareholders of some of the electric lighting companies, says the *Echo*, to notice the profitable business that is being done by the more solid firms in fitting steam vessels. Scarcely a vessel of any size is now despatched on her maiden voyage without being fitted with the electric light, only the sailing ships being doomed to use the old oil lamps, which are the abomination of passengers. No transatlantic steamer can nowadays depend upon securing passengers unless it is fitted with the electric light; and, as a matter of fact, the extra cost is so small that they are all being fitted as rapidly as possible.

At a meeting of the St. George's Vestry, on Tuesday of last week, the clerk, in reply to a question, said the cheque for £34 12s. 3d. for Messrs. Simson, Wakeford and Co. comprised the whole cost of the opposition of the vestry to the Electric Lighting Bill. The opposition was very successfully carried out, the vestry having obtained all the clauses they had asked for.

For a *soirée*, held at Guy's Hospital on Monday evening last, the Hammond Electric Light Company put up an installation of more than 100 incandescent lights of 20-candle power each. The current for these was supplied from "Sellon-Volckmar" accumulators. These were brought to the place in two vans, and the wires connected to them without the necessity of unloading. The entire work in connection with this installation was done in about two days and a half.

The contract for the lighting of Messrs. T. Boyd and Co.'s large print works at Levenshulme, Manchester, has been secured by Mr. Goold, electrical engineer, representing the Hammond Electric Light Company, and Messrs. Ferranti, Thompson and Ince, of London. The lighting will include 150 Swan 20-candle power lamps, the current being obtained from a Ferranti dynamo.

A steel screw steamer for the New Zealand Shipping Company, for their direct service between England and New Zealand, was launched on Tuesday from the shipbuilding yard of Messrs. John Elder & Company, Fairfield, and named the *Aorangi*. The vessel, like her sister ship the *Tonguriro*, will be electrically lighted throughout.

During the sitting of the Reform Conference at Leeds, on the 18th inst., we learn that Messrs. John Fowler & Company will, by a powerful electric light, illuminate Victoria Square.

At the close of the meeting of the Iron and Steel Institute at Middlesborough, last week, a grand reception and conversazione was given at Marton Hall by Mr. Bolckow, where, we understand, through the courtesy of Mr. Robert Hammond, the splendid conservatories were lighted throughout with Swan lamps for this special occasion. The reception was held on Friday evening, 21st ult., and on Wednesday afternoon Mr. Hammond, who was in Middlesborough, telegraphed to the company's works to charge twenty-five Sellon-Volckmar secondary batteries. These were charged during the Wednesday night, and were sent down by passenger train to Middlesborough on Thursday. The batteries were placed in an adjoining building, and the whole of the wires and lamps fixed in the conservatories during the Friday, the whole of the lights being switched in at 7 o'clock, and running without a hitch till 1 a.m. the following morning.

A lecture on "The Electric Light, its simplicity, practicability, development, and probable future," was delivered at the Oxford Hall, Ilfracombe, on Thursday evening, the 27th ult., by Mr. J. B. Braithwaite (chairman of the Great Western Electric Light and Power Company, Limited). The building was lighted with electricity, and the effect surpassed every expectation.

The High Street at Winchester has, for the past fortnight, been illuminated by seven arc lamps, suspended midway between the houses on either side of the street. The first lamp is fixed at the Western Gate and the last near the new Guildhall. On the whole the illuminant may be counted as a successful experiment, but occasionally there has been an unsteadiness and intermittency in the light which will doubtless be remedied when the machinery has been longer at work.

Telephonic.—In our last issue we mentioned a rumour, which we had been unable to verify, to the effect that an injunction had been obtained by the United Telephone Company, restraining a certain opponent from using, for the present, the "Mechanic" receiver. Having had time to make inquiry, we believe that there is no foundation for the report which has been spread; indeed, if the London and Globe Telephone Company was intended, as the prohibited party, we are authorised to deny the truth of the rumour.

It is contemplated to connect the hall, in which the musical festival at Leeds is to be held, by telephone with Bradford, Halifax, and other Yorkshire towns, in order that the proceedings may be heard in those places.

The West India and Panama Telegraph Company.—The s.s. *Grappler*, Captain J. Cole, with 250 N. miles of cable, made by Messrs. Siemens Bros., and a supply of grappling rope, instruments, &c., left the river this week *en route* for the West Indies.

The Spanish National Telegraph Company's Cables.—The India Rubber, Gutta Percha, and Telegraph Works Company inform us that they have received a telegram from Mr. R. K. Gray, engineer-in-chief, stating that the s.s. *International* and s.s. *Dacia* arrived at Cadiz on the 27th and 28th ult. respectively. All well.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Electric Sun Lamp and Power Company, Limited.—Under an agreement of 18th ult., this company will allot to the London Agency, Limited, and its nominees 3,990 fully paid shares of £5 in payment of the balance due under the agreement dated 25th July, 1882, for purchase of letters patent.

Economic Electric Company, Limited.—A return of this company was filed on 26th ult. In lieu of specified capital, every member guarantees to contribute to the assets, in the event of winding up, any sum not exceeding £1. The following is a list of directors and managers:—R. Barlow, Albion Road, Dalston; J. B. Boley, Ealing; F. E. Brewer, 6, Sheffield Terrace; Lieut.-Col. P. A. Brown, Buseldon, near Reading; S. H. Emmens, 8, Argyll Street, W.; Lieut.-Col. F. V. Eyre, Bracknell,

Berks; W. J. F. Hunt, 8, Duke Street, St. James's; F. J. Lilley, 222, South Lambeth Road (resigned as director); J. Munro, 2, Somerset Villas, West Croydon; C. Penruddocke, J.P., Salisbury; Captain P. M. Syme, R.A., Ashford, Kent; H. Beaumont, 21, Ashburnham Grove, Blackheath Hill (resigned as secretary.) Registered Office, The Economic Works, Durham Street, Strand.

Electric Company, Limited.—A return of the directors and managers of this company was made on 26th ult., the following being a list, viz.:—Francis Eustace Burke, C.E., Members' Mansions, Victoria Street; G. C. Vincent Holmes, C.E., 13, Sussex Villas, Cornwall Road; Stephen Henry Emmens, electric engineer, 8, Argyll Street, Regent Street. Registered Office, Adelphi Electric Works, Adelphi Terrace, W.C.

Electro-Amalgamator Company, Limited.—By an agreement dated 12th ult., and filed on 29th nlt., this company will allot to Mr. Richard Barker, of Seacombe, 15,000 shares of £5 each, credited as fully paid, in full satisfaction and discharge of the moiety of the net profits of the old company to which he is entitled under an agreement of 30th October, 1882.

Removal. — Electrolysis Company, Limited. — The offices of the company have been changed to 49, Queen Victoria Street.

CITY NOTES, REPORTS, MEETINGS, &c.

The Jablochkoff Electric Light and Power Company, Limited.

THE ordinary annual general meeting of the shareholders was held at the Cannon Street Hotel on Thursday.

The report of the directors says:—The directors are desirous of making the fullest possible statement to the shareholders upon the operations of the company since its formation in May last year. The "Jablochkoff" system of lighting, the first practical one introduced into this country, had been in operation on the Victoria Embankment for more than three years, and a contract existed with the Metropolitan Board of Works for lighting the 50 arc lights on the Embankment and Waterloo Bridge at a price of three halfpence per light per hour. The lighting was for six hours only, but it was intended to be extended from sunset to sunrise. It was understood that this contract, although not remunerative, would at any rate pay the cost of working it; as a matter of fact, it entailed a considerable annual loss, which has since been decreased by reduction of expenditure. It should, however, in justice be remembered that this contract formed a most excellent advertisement for the company's business. The lighting station at Charing Cross, a long wooden shed, with a 20 H.P. steam engine and dynamos, was the only workshop the vendors possessed. The other business of the vendors consisted in the supply of imported Jablochkoff candles and repairs of fittings for the different customers in London and the provinces, such as Messrs. Whiteley, Shoolbred, Samuel Bros., Nicoll, Crocker, Wells, and others. In order to carry out the more extended lighting of the Victoria Embankment, the Metropolitan Board of Works allotted the company a site in the Embankment Gardens for a new engine-house. They supplied the design and specification for the building, the erection of which was let to a contractor, to whom £1,000 has been paid on account. Owing, however, to the outcry raised against the railway ventilators on the Embankment, pressure was brought upon the Board of Works, who have decided that the building must not be completed, but be removed. The new Victoria lighting station was to be capable of supplying a large number of lights in the neighbourhood, and the directors accordingly secured an order for the fitting up of the Gaiety Restaurant in the Strand, but considerable delay was caused by the decision of the Metropolitan Board of Works as to the new building, and it became necessary to obtain premises for another lighting station. These were secured at 65, Belvedere Road, Lambeth, close to Waterloo Bridge. Two powerful steam engines and boilers, by Messrs. Marshall, of Gainsbro', have been fixed there, together with a complete arrangement of shafting, pulleys, dynamos, and instruments. Electric cables have been carried from this station across the river into the Strand and Covent Garden districts. The introduction and passing of the Electric Lighting Bill by Parliament materially interfered with the progress of business. The Bill laid down a new plan of operations, and gave to the local authorities obstructive powers for the time being. After long negotiations, an agreement was made with the Marylebone Vestry for a licence for the most important section of their parish, bounded by Edgware Road and Oxford Street, and another agreement was made with the Strand District Board of Works for the whole of their parishes. Having made these agreements, the directors congratulated themselves in thus early securing the object for which the company was formed, and obtaining an amount of business which, while it would require a larger capital to carry out, would yet return such a handsome profit upon the outlay, that there would be no difficulty in raising the necessary capital, and the directors looked upon the success of the company as assured. Unfortunately the Board of Trade had determined that the "Edison" and "Swan" Companies should, in spite of the opposition of the Strand authorities, have the lighting of that district, and therefore granted those companies provisional orders. The company has supplied installations of the electric light for various places, among others may be mentioned the Covent Garden Theatre and Floral Hall; the Gaiety Restaurant; Lindal Moor Mines; Wormersley's, Canning Town; the Fisheries Exhibition; Sir H. Vivian's copper mines, Norway; Newhaven Harbour; Aston Gardens, Birmingham; the Metropole Hotel Works; Warkworth Harbour; the new Lyceum Theatre, Edinburgh; the Crieff Dye Works; &c. The Board of Trade will, it is understood, grant a licence to the company for a section of the Marylebone parish, and negotiations are proceeding for other large contracts, the particulars of which cannot, for obvious reasons, be mentioned. The light is now being fitted up at the Gaiety Theatre, Glasgow; the Avenue Theatre, London; and Messrs. Clark's printing works, Edinburgh. The formation of subsidiary companies received the early attention of the directors, but owing to the rapid depreciation in the market value of the shares of other companies, it has not been possible to make much progress in this direction. Lately, however, the matter has been revived, and preliminary arrangements have been made for the starting of a company for Scotland. There seems likely to be a large business in North Britain, and the "Jablochkoff" system is there in high favour. The successful formation of a Scotch company would, no doubt, greatly strengthen this company, and every effort is being made to carry this out. The directors view the operations of the year just concluded as a preliminary foundation for future business, and, therefore, they have not thought it proper to submit a profit and loss account, but have carried the whole expenditure, other than capital, to a suspense account, deducting from it the amount of work done. The manufactured stock and other property has been entered at *cost price*, and the whole business is in a sound and efficient state. Gradual and steady progress is being made in the reduction of the cost of all the articles made by the company, the effect of which is greatly to increase future profits; at the same time experiments are constantly being made to improve and perfect the Jablochkoff system. A much larger business might have been done had the directors been content to take work at less than cost price, but this the directors were not, in the interests of the shareholders, prepared to do. The directors have been obliged to obtain advances from the company's bankers upon the security of the calls, and this was done in the confident assurance from first-class brokers that they would find any amount of additional capital to carry out the Marylebone and Strand licences. To carry on and properly develop the business, it is necessary that further capital be provided, and the directors have decided to issue debentures to an amount of £20,000, bearing 7 per cent. interest, and secured upon the whole property of the company; a form of application is enclosed with this report, and it is requested that the same may be filled up and returned without delay. The directors submit this record of their labours to the shareholders with the knowledge that they have done their duty to the company in establishing a large and increasing business, which, but for the action of the Board of Trade, would have been all that could be desired. However, they are confident, if properly supported, there is a most successful future for the company, as the "Jablochkoff" system of lighting is proved to be the cheapest, simplest, and best adapted for all purposes.

The Swan United Electric Light Company, Limited.

AN extraordinary general meeting was held at the Cannon Street Hotel on Tuesday, "for the purposes of considering and, if approved, of adopting and confirming the terms of an agreement about to be entered into and to be made between the Edison Electric Light Company, Limited, of the first part, the Swan United Electric Light Company, Limited, of the second part, and a trustee for and on behalf of a company intended to be registered under the name of the Edison and Swan United Electric Light Company, Limited, of the third part, being a conditional agreement for the sale to the last mentioned company of certain of the business, goodwill, patents, rights, privileges, and other property of the Swan United Electric Light Company, Limited, and of empowering the directors to do all such things as may be necessary for carrying such agreement into effect, with such modifications and additions (if any) as they may find necessary." Mr. J. S. Forbes, the chairman of the company, presided, and there was a large attendance of the proprietors.

The Secretary (Mr. J. H. Ivory) having read the notice convening the meeting,

The Chairman said it would be his duty to present to them the agreement, and to dwell somewhat upon the conditions of this proposed amalgamation. He did not know whether many of those present attended the first meeting of the Swan Company, but if they did they would remember that when the directors suggested the possibility and the wisdom of bringing together diverse interests in that new and somewhat difficult enterprise, there was a very general concurrence of feeling as to the wisdom of that course. That almost unanimous expression of opinion the directors had kept steadily in view. One needed hardly say that the electric light business was very novel. He himself had been working away at it for, he thought, two or three years, and yet he

confessed that he knew very little about it—he meant to say it was so essentially a thing to be worked out, and the data and experience on which they had to proceed was so very limited that it was beset by uncommon difficulties. Those difficulties would certainly not be diminished by conflicting interests, and particularly by conflicting interests manifested by those particular inventors or inventions which, in the public opinion, seemed, at all events, to stand in the forefront in regard to the great invention itself. He did not know which name one ought to take off one's cap to —whether it were that of Edison or that of Swan—but he thought everybody would agree that those were two names which would be much more powerful in association than in competition. A great many things had to be settled before it appeared politic to move very far in the direction of amalgamation. They had specially to consider what the effect of legislation was to be, because it was quite certain that electric lighting on a large scale could not proceed without legislation, not that there was not a very wide field for it in private enterprise, but that after all it would be very difficult to separate private from public business; and he thought both companies had adopted a prudent and a reasonable course in waiting to see what the tenure would be upon which they would have to proceed under Acts of Parliament or the Provisional Orders. Happily, they had arrived at the stage at which they had some indication of the ground upon which they were treading—some appreciation of the tenure and condition of the privileges they had sought—and they had come to the conclusion that they could now safely proceed to unite these companies. He hoped that the wisdom of the principle of fusing two interests like those of the Swan and Edison would be admitted without much discussion. Of course, all fusions viewed from one side or the other were good or bad, according to the conditions upon which they were effected, and he would be frank with them as to the prevailing principle in the minds of the negotiators in the matter. He dared say gentlemen before him were pretty well conversant with the warning about not buying a "pig in a poke," but it was astonishing the number of "pigs" bought in that position—(laughter)—because in every case where they had to deal with the unknown—where they had to estimate the indefinite—they must more or less buy a "pig in a poke," and theirs would be just some such sort of a transaction. They, on their part, had paid considerable sums of money for patents, &c., and the Edison Company had paid considerable sums of money for patents, &c. Well, both the vendors of those patents did what vendors always did—they took the money, but declined to guarantee the validity of the patent; and, in fact, there was no patent the validity of which could be guaranteed, because the moment patents turned out to be of great public merit, they were partly challenged, and could only be established after a course of costly litigation. Now, they bought the Swan patents, and the Edison Company bought the Edison patents. Each company of course at once proceeded to prove that it was the real "Simon Pure," and what had rather assisted the proposed amalgamation—he only said assisted—was the fact that they were drifting into that position. The Swan patents were being challenged by Mr. Edison, or the Edison Company, and the Edison patents were being challenged by Mr. Swan, or the Swan Company, and they were both on the eve, and in fact had proceeded some distance, with the preliminary measures to see if they could establish their rights. Of course if the proprietors thought it would be desirable, in view of some imaginary unascertained future possible benefit, to go on litigating, and to endeavour to establish Mr. Swan as the inventor, and no other, and to leave Mr. Edison out in the cold, or the reverse, then that course was open to them, but it would take a great deal of time and cost a great deal of money, and it would weaken both companies very much in reference to the work which lay before them. Both companies had paid so much money for their patents, and had spent so much in bringing them up to their present stage, and each company had, in fact, taken the expenditure on these patents up to the present time as that on which each company was to fuse into the common whole. It might turn out that both companies might make a very bad bargain, but as between themselves the bargain was very fair. The outcrop was this—all the —should he call it—the British business of the Edison Company was proposed to be fused with all the British business of the Swan Company. There was the difference between the two companies, that the Swan Company had over and above British business paid a considerable price for foreign patents and colonial patents. They found, eliminating from their books the purchase money of the foreign and colonial patents, and the outlay they had incurred in advertising and conducting them so far, that they had spent £183,847 in the Swan Company, and that the Edison Company had spent £100,000; and he must explain another difference between them and the Edison Company, in order that they might understand that the figure of £100,000 would be swollen to £125,000. Their purchase of Mr. Swan's patents was "out and out"—a lump sum—while in the purchase of the Edison patents there was a deferred interest to Mr. Edison—a percentage of the profits. After the £100,000 had been covered by 5 per cent., the Edison Company and Mr. Edison were to participate half and half in the surplus. They found they could deal with the Edison Company as a company about the indefinite future, but Mr. Edison himself was in possession of a distinct right to do a particular thing, and Mr. Edison elected to exercise his right, which was, instead of taking the cash for his half share—his deferred interest—to take shares under his contract agreement with the original company, and after a good deal of discussion—he would not say a beating-down unduly—the directors of the Swan Company came to the conclusion that they had better get this half share of future profits over 5 per cent. attaching to the Edison Company as distinguished from Mr. Edison himself out of the way by a payment of £25,000 in shares. Mr. Edison elected to remain where he was, and his position was this: he was entitled under his original agreement with the Edison Company to one B share bearing deferred interest for every two Edison Company's shares. To sum up the whole, the Swan Company proposed to make over all they possessed, with the exception of their foreign and colonial patents, for £183,847, and the Edison Company would transfer everything they possessed, including their half share of the contingent profits under the agreement of the Edison Company for £125,000. They might increase the capital as much as the necessities of their business required, but for every £100 of that capital Mr. Edison would take one B share; for every £75 of theirs Mr. Edison got £25 in the nature of a deferred share. The agreement on which he might say substantially the parties were agreed was as follows:—

An agreement made the 1st day of October, 1883, between the Edison Electric Light Company, Limited (hereinafter called "The Edison Company") of the first part, the Swan United Electric Light Company, Limited (hereinafter called "The Swan Company") of the second part, and George Black, of 21, Burghley Road, Kentish Town, in the County of Middlesex, gentleman, as agent for and on behalf of a company intended to be registered under the name of The Edison and Swan United Electric Light Company, Limited (hereinafter called the "United Company") of the third part. Whereas it is intended that the Edison Company and the Swan Company respectively shall, for the considerations hereinafter appearing, sell its business, goodwill, and other property (with the exception set forth in the second clause hereof) to the United Company, subject to the provisions and otherwise in the manner and upon the terms hereinafter expressed. And whereas a print of the proposed memorandum and articles of association of the United Company has been approved by the parties hereto of the first and second parts.

Now it is hereby agreed as follows:—

1. The Edison Company shall sell to the United Company, and the United Company shall purchase from the Edison Company, all the business, goodwill, patents, rights, privileges, and other property whatsoever of the Edison Company.

2. The Swan Company shall sell to the United Company, and the United Company shall purchase from the Swan Company, all the business, goodwill, patents, rights, privileges, and other property whatsoever of the Swan Company, except only the foreign and colonial patents, and the rights and privileges connected therewith, and the business and goodwill of the Swan Company without the United Kingdom.

3. The sale by each of the selling companies shall take effect as from the 30th June last, as from which date each selling company shall as between itself and the United Company be deemed to have carried on and to be carrying on the business hereby agreed to be sold for and on account of the United Company. The United Company shall as between itself and the selling companies respectively take over and discharge all the debts and liabilities of the said selling companies respectively as on 30th June last (except such portion of the debts and liabilities of the Swan Company as are in respect of the property not sold by them as aforesaid), but so that nothing in this clause shall be deemed to extend the rights of any third parties, or to create any direct liability between them or any of them and the United Company.

4. As the consideration for such sale by the Edison Company, the United Company shall allot to the Edison Company, or as it may direct, 45,000 ordinary or A shares of £5 each, part of the original capital of the United Company, 40,000 of such shares shall be issued as shares upon which the sum of £2 10s. has been paid up, and the remaining 5,000 shares shall be issued as fully-paid shares. The Edison Company shall have the option (to be exercised in writing within three months from the date hereof) of requiring that in lieu of any of the said 5,000 shares the United Company shall allot to it, or as it may direct, twice the number of ordinary or A shares, to be issued as shares upon which £2 10s. per share has been paid up. The United Company shall also from time to time issue (as further part of such consideration) to the Edison Company, or as it may at any time hereafter direct, fully-paid up B shares of £5 each in the following proportions:—One fully-paid up B share for every £15 paid up, or credited as paid up, on the A shares of the United Company, whether such A shares form part of the original capital of the United Company, or of any increase of capital. The said B shares shall not be entitled to receive any dividend until there has been paid as dividend on the ordinary or A shares of the United Company a sum equal in the aggregate to a preferential cumulative dividend of 7 per cent. per annum on the amount paid up, or credited as paid up, on such A shares, but after such dividend has been paid the surplus profits available for dividend shall be divided between the A shares and the B shares, in proportion to the amount paid up, or credited as paid up, thereon, subject to the provisions of Clause 5 in respect of the A shares to be allotted to the Swan Company as fully-paid up shares. The voting power of the B shares shall be one vote for every two shares, each A share being entitled to one vote. In the case of a winding-up, the holders of A shares shall be entitled to receive in full the amount paid up, or credited as paid up, upon their shares, with any arrears of the 7 per cent. dividend, in priority to any payment to the holders of B shares, and any surplus of assets then remaining shall be distributed in the proportion of one-fourth among the holders of B shares and three-fourths among the holders of A shares, but this

provision shall not prejudice the rights of the holders of A shares *inter se* in respect of A shares issued under special conditions.

5. As the consideration for such sale by the Swan Company, the United Company shall allot to the Swan Company, or as it may direct, 61,400 ordinary or A shares of £5 each, part of the original capital of the United Company, 49,261 of such shares shall be issued as shares upon which the sum of £2 10s. has been paid up, and the remaining 12,139 shares shall be issued as fully-paid shares. Such last-mentioned fully-paid shares shall participate in dividends with the other ordinary or A shares in proportion to the amounts from time to time respectively paid up, or credited as paid up, thereon, until such dividends shall in each year amount to £5 per centum per annum upon the capital paid up, or credited as paid up, and thereafter such last-mentioned fully-paid shares shall in each year rank for dividends without reference to the amount credited as paid up thereon, and each such share shall receive the same amount of dividend as each other ordinary or A share to be allotted to the Swan Company, irrespective of the amount for the time being paid up thereon. The Swan Company shall have the option (to be exercised in writing within three months from the date hereof) of requiring that in lieu of any of the said 12,139 shares, the United Company shall allot to it, or as it may direct, twice the number of ordinary or A shares, to be issued as shares upon which £2 10s. per share has been paid up.

6. The United Company shall have full power hereafter to issue any of the ordinary or A shares, part of the original capital of the company, or any A shares of increased capital, as preferential, guaranteed, or deferred shares, provided that in no case shall the rights of the B shareholders to participate in the profits of the United Company in manner hereinbefore provided by Clause 4 be thereby interfered with, or their interest in the profits of the United Company diminished.

7. All necessary contracts shall be executed by the United Company and registered prior to the issue of the said shares referred to in clauses 4 and 5.

8. The purchase shall be completed on the 31st day of October instant, whereupon the said shares shall be allotted to the Edison Company and the Swan Company respectively or as they may respectively direct, and each of the said companies shall thereupon deliver such of the property hereby by it agreed to be sold as may be capable of delivery, and shall execute and cause to be executed by all necessary parties, all proper assignments and conveyances of the residue of the property hereby by it agreed to be sold, including the said Letters Patent.

9. The patents hereby agreed to be sold to the United Company shall be assigned to Thomas Alva Edison, the Swan Electric Light Company, Limited, and R. E. Crompton & Co., or such one or more of them or to such other person or persons as the United Company may desire, in trust for the United Company, and such assignments shall be duly registered. A proper deed of trust, containing the necessary powers for using the names of the trustees in case of litigation relating to the patents, shall be drawn up and executed prior to such registration.

10. The United Company shall indemnify and keep harmless the Edison Company from all claims against it, of whatever nature, arising previously to the 30th June last (other than claims under the agreement of the 18th day of February, 1882, scheduled to the articles of association of the Edison Company, except those under clause 15 of the said agreement), and shall bear and pay all costs and charges of, and incidental to, the carrying out of this agreement and the winding-up of the Edison Company.

11. The United Company shall indemnify and keep harmless the Swan Company from all claims against it, of whatever nature, arising previously to the 30th June last (other than claims arising out of or connected with the property not sold by them as aforesaid), and shall bear and pay all costs and charges of, and incidental to, the carrying out of this agreement and the winding-up of the Swan Company, in case it shall determine to be wound up upon the execution of this agreement or within six months thereafter, but such costs shall not be increased by arrangements relating to the property not sold by them as aforesaid.

12. The Edison Company and the Swan Company shall each, if the necessary resolutions for confirming this agreement are passed at the meetings of the respective companies which have been called for the 2nd day of October instant, forthwith take all such steps as may be necessary to carry out this agreement in accordance with its true intent.

13. If the shareholders of the Edison Company or of the Swan Company refuse or neglect, on or before the 31st day of October instant, to confirm this agreement, or to pass any resolution necessary for giving effect to the same, then in either of such cases, either of the companies parties hereto may rescind this agreement by notice in writing to the other.

14. Neither the Edison Company nor the Swan Company shall be deemed to warrant the validity of any Letters Patent hereby agreed to be sold nor be liable for the non-performance by the other of anything hereby agreed to be done, but each of the said companies shall be deemed to guarantee that it has not granted any licenses to make, use, or vend the inventions the subject of the said patents or any of them, save in respect to plant lamps or other articles made and already sold by them, except those scheduled hereto.

15. Each selling company shall use its best endeavours to procure the assignment to the United Company of all property hereby agreed to be sold, and shall, meanwhile, hold the same in trust for the United Company.

16. The said George Black shall incur no responsibility whatever under this agreement, but so soon as the same is adopted and confirmed by the United Company the same shall be binding on such company in the same way as if entered into under its common seal.

17. If any doubt, difference, or dispute shall arise between the parties hereto or any of them as to the construction of this agreement, or as to anything to be done or money to be paid hereunder or otherwise as to anything herein contained, the matter in difference shall be referred to some person agreed on between the parties, or, in case of difference, to be nominated by the President of the Incorporated Law Society for the time being, whose decision shall be final, with power to him to nominate any other person in the event of the death or refusal to act of the person first nominated.

THE SCHEDULE ABOVE REFERRED TO.

LICENSES GRANTED BY THE EDISON COMPANY.

1882, August 10th, and 1883, February 27th, license to the Manchester and District Edison Electric Light Company, Limited.
1882, August 11th, license to the British Electric Light Company, Limited.
1883, August 3rd, agreement respecting lamps with the Telegraph Construction and Maintenance Company.

In witness whereof the Edison Company and the Swan Company have hereunto respectively set their common seal the day and year first above written.

In that agreement, continued the chairman, two great names were brought into conjunction, and the Edison Company, and also Mr. Edison rather, made a point of having Mr. Edison's name first. No doubt Mr. Edison would like to have his name identified with the great discovery exclusively, but in justice to Mr. Swan they could not agree to that. Mr. Swan, however, with a degree of kindness, and he might say generosity, did not appear to attach such an immense value to having his name first as to warrant him breaking up a bargain so advantageous to both sides. They believed the proposed agreement to be reasonable and just to both parties, and he moved that it be agreed to.

Major-General Trevor seconded.

In reply to questions,

The Chairman said the business of the Swan Company, as represented in the British patents, would merge into the new company, and a holder of shares would receive in proportion to his holding shares in the new company, and would retain, in respect to the foreign business, shares in the existing company. When the amalgamation was completed, they would have to consider what was to be done in regard to the foreign patents. As regarded the Swan Company now existing in Britain, it would disappear. He was not quite in a position to say as to whether or not there was any profit attaching to the Swan Company, but he thought it would not be a bad outcrop if after striking a balance, as at the 30th June, they found their capital intact. (Hear, hear.) He thought they had now arrived at the threshold of a great future, and they must carefully feel their way, and not commit themselves to any extravagant bargain.

The resolution was unanimously carried, and a vote of thanks to the chairman and directors closed the meeting.

The Edison Electric Light Company, Limited.

AN extraordinary general meeting of this company was held on Tuesday at the Cannon Street Hotel, Mr. John Stewart in the chair, in the absence of Sir John Lubbock, M.P., to consider and agree to the terms of an amalgamation with the Swan United Electric Light Company, Limited. After explaining the reasons which had induced the directors to recommend the amalgamation to the shareholders, the chairman put the following resolution to the meeting:—"That the agreement dated the 1st day of October, 1883, between the Edison Electric Light Company, Limited, of the first part, the Swan United Electric Light Company, Limited, of the second part, and George Black, on behalf of the Edison and Swan United Electric Light Company, Limited, of the third part, be, and it is hereby approved, adopted, and confirmed, and the directors are hereby empowered to do all such things as may be necessary for carrying the said agreement into effect." The Right Hon. E. P. Bouverie, in seconding the resolution, which was carried unanimously, observed that a great impediment to the success of electric lighting would be removed by the fusion of the two companies, as the Swan Company was practically the only dangerous competitor they had to face. The chairman stated that the company had been doing very successful ship-lighting business during the past half-year, the turn-over during that period equalling that for the whole of the previous year. Mr. Arnold White, a director of the company, observed that it might be interesting to know that the first ship in the world which had been lighted by electricity without any subsidiary form of lighting being employed was the Guion Line *Oregon*, which was to sail on the 6th inst. This vessel was lighted throughout by the Edison system.

The Brush Electric Light and Power Company of Scotland, Limited.

THE second ordinary general meeting of the shareholders of this company was held at Dashwood House, New Broad Street, on Friday of last week, for the purpose of receiving and considering the annual statement of accounts and balance-sheet, and the report of the directors, and to transact other business of

the company. The Right Hon. the Earl of Crawford and Balcarres, chairman of the company, presided.

Mr. F. M. Brockelbank, secretary, having read the notice convening the meeting,

The Chairman said:—I now ask the gentlemen present whether they will take the report and the balance-sheet as read? ("Yes; taken as read.") Gentlemen, the last time I had the honour of appearing before you we had hoped to carry out certain arrangements which we believed at the time were for the interest of the company. However, as I daresay you will recollect, certain members of the company objected to that scheme, but at that time, and afterwards, we have been advised, we were acting within our powers, and with those of the general interest of the company; still it was felt desirable that we should take further opinion, which we did, and although desirous of carrying out matters within our power, still we thought there might be objections to it, and consequently it was considered desirable that we should drop the matter, as you have consequently been informed we have done. Gentlemen, the circular before you is the result of very careful consideration as to the best interests of this company. I think I may claim for your Board that they have done their duty towards their shareholders, and have exercised great care under the most difficult and trying circumstances. We have kept all the money we possibly could; we have utilized that money, though not as we might possibly have desired, in getting large contracts and putting up work. At any rate, you see none of that money has been thrown away or uselessly placed out in a manner that it should not be unfruitful. We have had, as you know, very great difficulties to contend with in Scotland, as the report tells you, from the excellence of the gas, and from the Scotch folk not caring to displace it with the electric light. But above all, I cannot help saying that the greatest difficulty we have had has been from our own Government and the way we have been treated, and electric lighting generally has been treated, to my mind is not at all encouraging for anyone who desires to bring in a new branch of industry for the working of capital in this country. I am sorry to say anything of such a nature of our Government, but I really think it is driving persons who wish to do good for the country, and at the same time to benefit themselves—it is driving them into other countries. We hoped, gentlemen, that the resolution which is to be brought before you will be carried, because we consider that it is far the best thing that can be done for the shareholders. We think, of course, that if you refuse to pass that resolution we could go on by the shutting up our office in London. We carry the thing on, selling a dynamo here and a dynamo there in Scotland; but I do not think, under the present circumstances and state of things, we should be doing a paying business, and the desire of the Board has been to place the matter frankly and plainly before you. I move now that the report and balance-sheet be received and adopted, and perhaps I may ask Mr. Dickson, the managing director, to give us some little account of what has been done.

Mr. Thos. Dickson said perhaps the shareholders would like to hear something as to how that *ultima thule*, the division, could be bettered. Taking the view which the chairman had taken, that was the unanimous view of the directors, that in view of the great difficulties which lie before the electric light, and especially in Scotland, situated as that company was with its peculiarity of shareholders and customers, they had determined to recommend the shareholders to wind-up voluntarily. In Scotland, he was sorry to say, his countrymen did not receive the electric light—the light of the future—in the way that the Board expected they would. The gas interest was very strong, and people who held shares in gas liked to hold them untouched. The two things going against each other, and backed as the gas was by the Legislature, rendered it exceedingly difficult, with all their endeavours there, to make any progress whatever. They were received in such an unfriendly spirit by all the town councils, that the Board found there was no hope of their making any progress. The town councils all combined, and put their affairs into the hands of Mr. Fleeming Jenkin to advise them, and the advice that he gave them would mean simply ruination to electric lighting companies. And so with this view in their minds, he went to see, with his co-directors, as to how that they could better their position. He went first of all to see what he could do with their father—the Parent Brush Company. This company saw the difficulty of the Scottish Brush, and they agreed to take back 2,800 £5 shares. He went in for the greatest good to the greatest number. But the rest of the shareholders had to be seen to and what he did for the benefit of the £5 shareholders would result in benefit to the £2 10s. holders. With the residue of the £5 shares he did what he could. He got a great deal of opposition from the north—from Mr. Hope, amongst others, who has since gone into liquidation—and it was an exceedingly difficult job. The Board desired now a friendly liquidation, with two classes of shareholders. They sent out with the report proxies. People, in a general way, allowed the proxies to drift, but they would be surprised to hear that the directors had received proxies amounting to nearly 15,000 shares of £2 10s. men. That showed the feeling of these men. Very few of the £5 shares had yet to come into the agreement, and he had no doubt those gentlemen would fall in with the recommendation of the Board when they heard his explanation, and take the money they had in hand. They would be agreeably surprised to see that the division would be quite equal to, or more than, what they asked to sell their shares for. A short time ago there were those who went in for electric lighting and lost their money. That company had gone "electric lighting mad," and had saved their money. He might be told that he had only spoken of one part of the assets; and how about the other? All the plant the company had put up he thought he could get a good price for. The plant put up at the railway station at Waverley had been arranged for by the railway company arranging to deal fairly and squarely with this Board. The light had given great satisfaction in every respect. He thought he should have no difficulty in getting that plant taken off their hands at a very fair rate indeed.

Mr. John Walker said, so far as the division of the shares went, so far so good; but he thought they should have a reduction in some other respects. With regard to the legal expenses, he felt very dissatisfied. The legal charges seemed to be enormous. Certainly calling these meetings were very expensive too, and if their advice proved bad, were the shareholders to pay for having bad law? They had advice one way once, and then called another meeting, and found that it was wrong. Were the Board really going to pay the solicitor all the expenses enumerated? The working of the company had already been a most disastrous thing for the shareholders. He, for one, had paid £3 premium for his shares, and now might have to part with them for £1 each. He thought it would be a right and proper thing if the gentlemen on the Board were to forego some of their fees. There was a large sum in the balance-sheet—"sundry administration expenses, £2,177." He should like to know if there could not be a reduction there? All this was coming out of the poor shareholders' pockets, and he hoped the Board would consider the matter, and see if some further reductions could not be made before they separated that day? What was about the return they would get, and when would they get it? He hoped, after those few suggestions, the Board would see if they could not relieve the shareholders of their great burden.

Mr. Peter Cunningham said he understood last year that measures were being taken to get the Anglo-American Brush Company to make some concession in the amount this company paid for the shares for the incandescent light. He believed the company had made concessions to other subsidiary companies.

Mr. Dickson said the Board took the best advice that they could, and they found they could not go against the Anglo-American Company. He thought when Mr. Cunningham said the Anglo-American Brush Company he must be confusing it with the Hammond Company.

Mr. P. Cunningham said he believed this company had received the sanction to the proposed arrangement from the holders of 6,500 £5 shares?

Mr. Dickson: Yes.

Mr. Cunningham: How about the founders' shares? Are they entitled to sell them? You said we had only paid £15,000 in cash; the rest we got, I think, in shares? It really depended upon the success of the company? When we pay *pro rata* upon the shares it comes to a very considerable sum.

Mr. Walker: It is a pity the shares were not tied up for a considerable time.

Mr. Dickson: At the time we purchased, the Anglo-American were masters of the situation. Everybody was running after them.

Mr. Walker: Has the late solicitor retired?

Mr. Dickson: Yes.

Mr. Walker: He has retired after giving us bad law? He ought to have retired long before.

Mr. Dickson said, with reference to the objection to the directors' fees, that he would not again sit down and work as he had for two or three times the amount. He believed he should be able to get something from the Anglo-American on account of the Dundee order, so that will reduce the preliminary expenses in that direction.

Mr. Walker: It is a poor look-out for those who paid £5 for their shares. I think we shall get about £1.

Mr. Cunningham said, while he sympathised with the directors, he had hoped for the prosperity of the company. They had certainly been buoyed up from time to time by the directors, and now that they had been in existence twelve months it had come to nothing. He would respectfully ask the Board whether, under all the circumstances, they could reasonably claim £1,500, although it would, perhaps, still be a little mean to ask them to forego some of it.

The Hon. Ashley Ponsonby (vice-chairman of the company) assured the shareholders that the Board of Trade had put insuperable and extraordinary trammels in the way of the working of the company, and in the way of the working of the electric light generally. They would not give the company a provisional order, and made laws most stringent against everything except gas. He certainly did think if they had been properly treated that this would have been a flourishing company. He took credit to himself that the Board had spent so little of the shareholders' money. Mr. Chamberlain and those associated with him had made electric lighting work extremely difficult.

Mr. F. W. Reynolds objected to the reproach of Mr. Chamberlain, whom he characterised as the best business man in the country. Were the Board winding-up the company on the ground of legislative enactments? They had not found that other companies had wound up through legislative enactments.

The Chairman said the enactment was, that at the end of 15 years the whole of the property of the company should be taken up by the persons whom they were serving, at a break-up price. He got the period lengthened to 21 years; but even then, he thought, it could be seen that the Board of Trade were doing certain things to benefit certain individuals.

Mr. Reynolds said Mr. Ladd knew that the Brush dynamo was

the best they had got. It seemed to him a regrettable matter that they should abandon what they had got, because the electric light was not wanted in Scotland yet, and because the Electric Lighting Act was defective.

The Chairman: No; not defective.

Mr. Reynolds: Well, you seem to have great difficulties in carrying it out. If you had Mr. Swan on your board you would not wind up. ("Question.") It seems particularly unfortunate that you should wind up in this particular manner. You know you have an honourable Board, and might we not have a pledge from the Board that they would not make any further call, and so try another year? ("No; no.") I only make the suggestion. It seems a pity that £40,000 should be completely thrown away. In the company on which I am on the board (the Great Western), we have reduced our directors' fees to £500. It really seems a great pity for the company to throw away its installation.

In reply to Mr. Walker,

The Chairman said that £1,500 was the estimate for Parliamentary charges. They certainly could not have foreseen these expenses, as there was no legislation on the subject when the company was formed.

Mr. Wm. Ladd (a director in the parent Brush) on being called on, said: In the first place, I merely refer to the cost of the concession, £55,000, which was paid by this company for the patents; but I wish the shareholders to understand that not one half of that sum went to the parent Brush Company. There is no man in London who has greater faith in electric lighting than I have, and I believe the Brush dynamo is the best in existence and will last long after others have done. I have full faith in the Brush machine. Then comes the question, why we have not succeeded? I believe it is solely on account of the Act of Parliament that was passed. I have come reluctantly to that conclusion, and when it was put to me at the Board, after all the difficulties that are put in our way, my opinion was given to the Board, taking all the circumstances into consideration, and the prospects of profits to this company if we carried on lighting under the difficulties of the Act of Parliament and under all the difficulties that were thrown in our way by the local authorities, and I said, "it is impossible to carry on lighting in Scotland at a profit."

A Shareholder: At present.

Mr. Ladd: Very well. You say "at present." What prospect have we of these things being altered for several years to come? and in the meantime your capital might be considerably diminished, so then we should have no capital to do the lighting when it is wanted.

The Chairman then moved the adoption of the report and accounts.

Mr. Walker: I shall move an amendment unless you make some reduction or concession of these fees.

The Chairman: I shall be willing to give up all the fees I ever had.

Mr. Walker: Are the solicitor's costs to be taxed, or will he have all he claims?

Mr. Dickson: I will look very carefully after that. He will not have a farthing more than he is entitled to.

Mr. Cunningham seconded the motion, but hoped the Board would make the shareholders some concession from their fees.

Mr. Walker: Will you take the sense of the meeting with regard to these expenses? I move that the directors be requested to reduce their fees to one-half.

Mr. E. P. S. Read said he should be very sorry to second that, and hoped no one else would. They had confidence in their directors, and if they had shown them that they had husbanded the money of the shareholders, he thought they ought rather to be thankful that they would get as much money as they would.

The Chairman: We have already saved more than the directors' fees—£39 more—by keeping the money out at interest. We have done our duty, and if the shareholders think we have not done our duty, we shall be perfectly willing to return our money—which, by the way, is never a pleasant thing to do.

The report and accounts were received and adopted, and the shareholders then constituted themselves an

EXTRAORDINARY GENERAL MEETING,

for the purpose of considering, and, if deemed expedient, passing, the subjoined resolutions, viz.:—"That the company be wound up voluntarily under the provisions of the Companies' Acts 1862 and 1867."—"That the vice-chairman, Mr. Robert Ewing, and Mr. Thomas Dickson, be, and they are hereby nominated liquidators for the purposes of such winding-up, and that the remuneration of the liquidators be fixed by the shareholders."

The Chairman, without comment, proposed the foregoing resolutions, which propositions were seconded by Mr. Walker.

Mr. Attwood said before that was passed he should like to ask one question. Mr. Ladd and others had said that the future is certain, and that the light would be wanted in Scotland sooner or later. Was it possible to keep the concession in their own hands? He saw that they got £14,000 for giving it up, and they gave £55,000 for it.

Mr. Dickson: If you don't give it up thus it will be forfeited.

A Shareholder said he should like to know if the parent Brush company were preparing to start a company in Scotland on the lines of this one?

Mr. Ladd: I have not heard a hint of anything of the kind.

The Hon. Ashley Ponsonby: The matter of winding-up was well considered by the Board, and they decided that they could not advantageously do as had been suggested—lay on their oars for a year.

Mr. Walker said he thought that the shareholders should be represented at the liquidation by one of their number. The directors had brought the company into existence, and now were going to bury it without the shareholders having a word to say. He thought it right that the outside shareholders should be represented by an outside shareholder.

Mr. Harrington opposed the suggestion. The Board had called them together and put the matter fairly before them, and now asked them to sanction a liquidation. By that means they would save some money, and he hoped their fate would be an example to other companies, to give up the idea that anything connected with a Brush company can be a success. (Laughter.)

The Chairman: Do you press your amendment, Mr. Walker?

Mr. Walker: I only threw out a suggestion.

The resolutions were then put and carried, and

Mr. Harrington said he thought the strongest expression of thanks was due to the Board. They had fought an uphill fight, and they had failed, and it was not every man who had the courage to admit that sort of thing.

The proceedings then terminated.

The Mediterranean Extension Telegraph Company, Limited.

AN extraordinary general meeting was held at the Cannon Street Hotel, on Friday of last week, Mr. Ashley Ponsonby presiding.

The secretary (Mr. E. Tombs) having read the notice convening the meeting,

The Chairman explained that they had met to confirm or reject the two resolutions which were passed at the extraordinary meeting of the shareholders, held on the 3rd ult. Before proceeding with the business of the meeting, however, he wished to say that he had received a letter from Lady Carmichael, requesting him to convey to the shareholders of the company her sincere thanks for their sympathy with, and kindness to, her in her great loss, in passing a resolution of condolence with her. He had now to move the confirmation of the following resolution:—"That the company be wound up voluntarily under the provisions of 'The Companies' Acts 1862 and 1867.'"

Mr. Burt seconded, and the motion was agreed to.

Mr. Burt moved the confirmation of the second resolution:—"That the Honourable Ashley Ponsonby, a director of the company, and John George Griffiths, a partner of the firm of Messrs. Deloitte, Dever, Griffiths & Co., accountants, London, and a shareholder of the company, be appointed liquidators for the purpose of such winding up, and that the remuneration to be paid to such liquidators shall be left to the decision of the shareholders at a future meeting."

Mr. Veares said it was suggested that the remuneration of the liquidators should be "hereafter" agreed upon. He did not doubt the honour of the proposed liquidators for a moment, but he preferred a definite understanding to a conditional one. To put it in plain English, he wanted some of his money back, and he wished Mr. Griffiths to say, as a shareholder, that he would do his best for the shareholders.

Mr. Campbell pointed out that the question of the remuneration of the liquidators was in the hands of the shareholders; it was not what this or that gentlemen thought he ought to have. The shareholders could give them just as many pounds, shillings, or pence as they thought proper.

Mr. Veares: I feel myself a fool, but when a man does the work can he make any charge?

Mr. Campbell: No.

Mr. Burt rather felt, with Mr. Veares, that it was unsafe to put themselves in the hands of liquidators without some arrangement being come to. No one could tell what work might have to be done. If little had to be done the remuneration would be materially small, but if a great deal had to be done the shareholders must recognise that and act accordingly. He thought, however, they wouldbe safe in leaving the matter in the hands of Mr. Ashley Ponsonby and Mr. Griffiths.

The Chairman said the liquidators only desired the expenses they incurred. They might have litigation; he hoped not; they did not apprehend much trouble. The shareholders could give them what they chose.

The motion was unanimously adopted.

A vote of thanks to the Chairman was passed, and,

The Chairman, in replying, said, he hoped the liquidators would be able to return the shareholders a satisfactory proportion of their money; they should do all they could to secure every shilling.

The meeting then separated.

The Direct Spanish Telegraph Company, Limited.

THE twentieth ordinary general meeting was held at the offices of the company, Leadenhall Buildings, Leadenhall Street, E.C., on Friday of last week, Mr. Neil Bannatyne, the chairman, presiding.

The Manager (Mr. C. Gerhardi) read the notice convening the meeting, and the directors' report, which we published in our last issue, was taken as read.

The Chairman said he had very little to add to the report. It stated that the receipts might be considered satisfactory in view of the fact that the Bilbao cable was interrupted from the 14th of January to the 23rd February, and again from the 9th March to the 2nd April. Well, notwithstanding that, he must say for himself, he was a little disappointed that their receipts had not been larger, even when the cables were working, but he believed

that was attributable to the stagnation of trade throughout Spain during that period, and that was more especially indicated by the falling off in the receipts on their Barcelona cable—in connection with business between the Stock Exchanges of Barcelona, Paris, Madrid and elsewhere. He was glad, however, to be able to say that their receipts for the first three months of this half year, especially for the current month of September, showed an improvement, and he thought they had every reason to expect that that improvement would continue to the end of the year. He trusted they would have no interruption of their cable to prevent that prosperity continuing. The traffic receipts in July amounted to £1,372, in August £1,513, and, on the estimate of four days, in September they would amount to £1,678, making £4,563, or a decrease of £883 as compared with the corresponding three months of last year. They had a very good half year in the latter six months of 1882, and he trusted the remaining three months of the present half year would equal the corresponding three months of last year. During the six months ended 30th June, the company's earnings amounted to £8,148, and the balance received from the Eastern Company under joint purse agreement to £1,773. This may be considered as satisfactory, as after the deduction of the £200 charged in this half year as the cost of opening the London station and of removing the general offices, the working expenses were only £26 more than those of the previous half year. The only item showing a considerable increase was that of salaries, and that was attributable to the opening of the London station on the 1st January; but on the other hand, against this extra expenditure for the London station, they were able to put down a larger amount for telegrams than they should otherwise have been able to, as by having their own office in London they only paid the Post Office the shilling rate per message on telegrams, to or from the provinces; and had they been at work during the whole half year, the total amount of rent paid for wire for Falmouth for the pneumatic tube with the central telegraph office, and other extra rents and salaries, would have been below the sum they should have had to pay the Post Office for telegrams collected and delivered in London, and besides this naturally they were causing a development of the traffic which would only be fully realised after the lapse of some time. As mentioned in the report, they were able to work direct from the London office to Spain without an intermediate station at Falmouth, where they were only obliged to keep a small staff. He moved that the report and accounts be adopted.

Mr. Etlinger seconded.

Mr. Dyet asked when the company was likely to commence the laying of the duplicate cable between England and Spain.

The Chairman replied that it was difficult to say; it would depend very much upon the state of the weather in the spring, and upon how they were situated. If they were getting on very well, and had a prospect of paying a dividend on their ordinary shares, they might see their way to make better terms for laying the cable than they would otherwise.

Mr. Dyet: You are waiting for a good opportunity?

The Chairman said they were. Their making themselves independent of an interruption by a duplicate cable would keep up their receipts. They did not suffer so much as they did before their joint-purse agreement with the Eastern Company; they had been several times advantaged by the arrangements they had entered into with the company. In August they had had their cable repaired at a decidedly less cost than before. During the time it was interrupted they received their proportion of the receipts from the Eastern Company just as if their cable had been working.

Mr. Dyet: You are not in a position to give the ordinary shareholders any kind of remuneration at this time?

The Chairman: No.

The report and accounts were then adopted.

The Chairman next moved—"That a preference dividend at the rate of 10 per cent. per annum, less income-tax, for the half-year ended 30th June, be, and is hereby declared."

Mr. J. D. Pender seconded.

The Chairman, before putting the resolution, explained that they had not yet got their final accounts, but that after paying the cable repairs they should still have a balance at the credit of the reserve fund of a little over £2,000, so that if they went on during the next three months at the same or a better rate of progress than during the first three months of the half-year, and had no interruption of their cable, they should have earned during the half-year a sufficient amount to pay the working expenses, and the preference dividend, and to have such a balance over as he thought would enable them to see their way not only to add a further sum to the reserve fund, but to pay some dividend to the ordinary shareholders. (Hear, hear.)

This resolution was likewise agreed to, and

A vote of thanks to the Chairman closed the meeting.

The Great Northern Telegraph Company, Limited.—Notice has been received by this company that a station has been opened at Tungchow, twelve English miles distant from Pekin, which latter city is reached by means of a regular courier service. The rate from England to Tungchow is 10s. per word, and for the transmission by courier from that place to Pekin an extra charge of 1s. 10d. per message is made. Telegrams for Pekin to be forwarded by this route should be addressed "Pekin post Tungchow." Telegrams are accepted at 119, Bishopsgate Street Within, E.C., and at all postal telegraph stations, and should be marked "*viâ* Northern." The laying of this company's new cables from Nagasaki to Shanghai has been effected, and the company's northern section, say between Wladiwostock, Japan, Shanghai, is thus duplicated, and now open for traffic. As the southern section, from Shanghai to Hong Kong, has also been duplicated by means of a cable laid by the Eastern Extension Telegraph Company, under agreement with this company (a cable which also gives Foochow direct telegraph connection), the whole line from London to Japan, China, and Hong Kong is now duplicated, in some places even triplicated, and the efficiency in the working of this line will thus in future be materially increased.

The Eastern Telegraph Company, Limited.—This company notifies the opening for traffic of a new station at Tungchow, about twelve miles from Pekin, and the establishment of a courier service between the two places. Telegrams should be directed "*viâ* Eastern."

The Globe Telegraph and Trust Company, Limited.—The directors announce the proposed payment of a dividend of 2s. per share on the original shares.

The Great Western Electric Light and Power Company, Limited.—The offices of this company have been changed to No. 4, Great Winchester Street Buildings, E.C.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations Oct. 3.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	2¼-2½	2¼-¼-2.
		Do. Do.	10	4⅛- 5½	4⅛-7/16
30,000	5	Australasian E. L., Power & Storage Co.	3	⅛- ⅜	
24,900	10	British Insulite Co., Ld., "A" Shares.	5	1 - 2	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	⅛- ⅜	
23,000	5	Gt. Western Electric Light & Power Co.	2½	..	
24,980	5	Hammond Elec. Lt. & Power Sply. Co.	2½	1⅛- 2⅛	2-1⅛.
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
172,500	1	Maxim-Weston Elec. Lt. & Power Co.	1	⅛- ¼	
..	..	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2	..	
..	..	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	2½	1⅝- 2⅛	2-1/16.
		TELEGRAPHS.			
2,116,400/.	Stk.	Anglo-American, Limited	100	46 - 47	46¼.
2,441,800/	Stk.	Do. Pref. { Def. receiving no div. until	100	78 - 79	78⅞.
2,441,800/	Stk.	Do. Def. { 6 p. c. paid to Pref.	100	15 - 17	16-16-⅛.
130,000	10	Brazilian Submarine, Limited	10	10⅛- 10½	10⅛-⅛-⅛-⅛.
16,000	10	Cuba, Limited	10	10½- 11	
6,000	10	Do. 10 per cent. Preference	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	5⅛- 5½	5.
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
65,000	20	Direct United States Cable, Ld., 1877	20	11½- 12½	12½-12.
100,000/.	100	Do. 6 per cent. Deb., repayable 1884	100	101 -103	
380,000	10	Eastern, Limited	10	10⅞- 11	10 11/16.
70,000	10	Do. 6 per cent. Preference	10	12⅞- 13½	
232,000/.	100	Do. 6 do. Debs., repayable Oct. 1883	100	100-102	
200,000/.	100	Do. 5 do. do. Aug. 1887	100	101-103	
200,000/.	100	Do. 5 do. do. Aug. 1899	100	103-107	
199,750	10	Eastern Exten., Australasia & China, L.	10	11⅛- 11⅜	11⅛.
320,000	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	106- 109	
500,000	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102- 106	102⅛.
140,000	100	Do. do. reg., repayable 1900.	100	102- 106	
100,000/.	100	Do. 5 per cent. Debenture, 1890	100	102- 105	
254,300/.	100	{ Eastern & South African, Ld., 5 p. c. { Mort. Deb. Rg. redeemable 1 Jan. 1900	100	102- 105	
345,700/	100	Do. do. do. To Bearer.	100	102- 105	
22,050	10	German Union Telegraph & Trust, Ld.	10	10 - 10⅛	
163,380	10	Globe Telegraph & Trust, Ld.	10	7⅜- 7⅞	7 1 1/8-16.
163,200	10	Do. 6 per cent. Preference	10	12⅛- 13	12 3/8-13/16.
125,000	10	Great Northern	10	12⅜- 13	
100,000/.	100	Do. 5 per cent. Debentures	100	100 -102	
300,000	100	Do. 5 per cent. Debentures	100	100 -102	
31,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	29⅜- 30½	
100,000	100	Do. 6 per cent. Debs., 1886	100	101-104	xd.
17,000	25	Indo-European, Limited	25	31 - 32	
38,148	10	London Platino-Brazilian, Limited	10	3½- 4	
12,000	10	Mediterranean Extension, Limited	10	1½- 2	
8,200	10	Do. 8 per cent. Preference	10	2 - 4	
9,000	8	Reuter's, Limited	8	8⅜- 9½	
280,000	Stk.	Submarine	100	229 -230	
58,225	1	Do. Scrip	1	1⅛- 2⅛	1⅛.
4,200	Cert.	Submarine Cables Trust	100	105 -108	
37,350	12	Telegraph Construction and Mainten.	12	33 - 34	
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -103	
186,750	5	Do. 2nd Bonus Trust Cert.	2½	1⅛- 1⅜	
30,000	10	West Coast of America, Limited	10	4⅜- 5⅛	
150,000	100	Do. 8 per cent. Debs.	100	105 -108	105¼.
69,910	20	Western and Brazilian, Limited	15	5⅛- 5⅝	
		Do. Preferred	7½	4⅝- 5	
		Do. Deferred	7½	⅝- 1⅛	
200,000/.	100	Do. 6 p. c.. Debs. "A" 1910	100	102 -106	
2,500	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	95 - 98	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	122 -124	
1,030,000/.	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	⅝- 1	
34,563	10	Do. 6 per cent. 1st Preference	10	6⅛- 6⅝	
4,669	10	Do. 6 do. 2nd do.	10	4⅛- 5⅛	
		TELEPHONES.			
154,165	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅛- ⅜	
200,000	1	Oriental Tele. Co., Nos. 80.001 to 300,000	⅜	⅛- ⅜	
100,000	5	United Telephone Co.	5	8⅛- 8⅜	

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines during the month of September was 2,651, estimated to produce £2,500, against 2,473 messages, producing £2,283 in the corresponding month of last year. The traffic receipts for the month of June, estimated at £2,700, realised £2,688.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for September are £1,701, as against £1,812 in the corresponding period of last year.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half month ended the 30th September are £2,217, as compared with £1,779 in the corresponding period of 1882. The April receipts, estimated at £7,442, realised £7,613. The May receipts, estimated at £6,432, realised £6,416.

NEW PATENTS—1883.

4473. "Insulated conductors, leads and cables for telephonic purposes." A. R. BENNETT. Dated September 19th.

4501. "Improvements in means for propelling cars or other vehicles by means of electricity, applicable in part to such vehicles when propelled by other means." P. R. ALLEN. Dated September 20th.

4521. "Means for effecting ignition of electric candles." W. D. GOOCH. Dated September 21st.

4531. "Construction of electric accumulators and secondary batteries." A. C. HENDERSON. (Communicated by G. Philippart.) Dated September 22nd.

4557. "Apparatus or electro appliance for touching up photographic pictures and other objects, also applicable for engraving purposes." E. G. BREWER. (Communicated by J. Geesbergen and Geruzet Fréres.) Dated September 24th.

4563. "Armatures for electric current generating machines." H. J. HADDAN. (Communicated by C. F. Brush.) Dated September 25th.

4573. "Portable electric lamps partially applicable to other purposes." R. BARLOW. Dated September 25th.

4576. "Method of, and apparatus for, facilitating the electrical transmission of news and other information, and the rapid publication of the same." G. L. ANDERS. Dated September 25th.

4578. "Dynamo-electric machines." W. P. THOMPSON. (Communicated by R. G. Sheehy.) Dated September 25th.

4585. "Galvanic batteries and means of obtaining electric currents therefrom." A. W. WARDEN. Dated September 26th.

4594. "Dynamo-electric machines." F. H. VARLEY, J. R. SHEARER, W. BEALE, R. H. PADBURY. Dated September 26th.

4609. "Electric clocks." W. P. THOMPSON, (Communicated by A. Winbauer.) Dated September 27th.

4612. "Electric accumulators." G. F. REDFERN. (Communicated by D. Lontin.) Dated September 27th.

4617. "Generating, regulating, measuring, recording and integrating electric currents." Sir W. THOMSON. Dated September 28th.

4619. "Apparatus for supporting electrical conductors, which invention comprises an improved method of adapting the roofs of houses or other buildings for such apparatus." J. SITZENSTATTER. Dated September 28th.

4638. "Electro-motors." O. MARCH, F. CHEESWRIGHT. Dated September 28th.

4657. "Construction and regulation of secondary voltaic batteries." H. F. JOEL. Dated October 1st.

4669. "Telephonic apparatus." E. GEORGE, F. A. POCOCK, J. S. & J. S. MUIR. *Complete.* Dated October 2nd.

4683. "Electro-motors." S. J. COXETER, H. NEHMER. Dated October 2nd.

4694. "Apparatus for transmitting and receiving audible messages or signals by means of electricity." A. F. ST. GEORGE. Dated October 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

78. "Electric fire alarm apparatus." W. C. GORDON. Dated January 5. 6d. Relates to improvements in electric fire alarm apparatus for hotels and other large buildings or structures, and it has for its object to enable an alarm of fire to be originated at any floor of a building, and the locality or floor from which the alarm emanated to be indicated upon every other floor, and the alarm to be sounded simultaneously in various parts of the building, so as to call the attention of the fireman or other person in charge in whatever part of the building he may happen to be, and at the same time convey immediate and precise information of the whereabouts of the outbreak. It has further for its object to enable all the indicators which have been so operated to be returned to their normal position from any one of them, as an intimation that the fireman or other person in charge has heard and attended to to the summons.

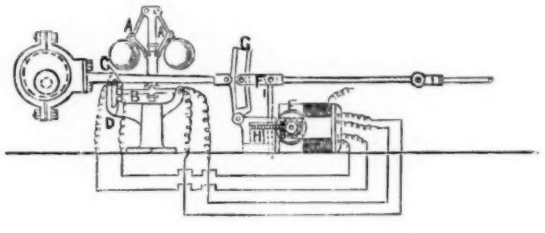
108. "Primary voltaic batteries." G. G. ANDRE. Dated January 8. 6d. According to this present invention, the inventor introduces air, or a suitable gas, under pressure sufficient to depress the level of the exciting liquid in the cell of the battery, so that the negative electrode (except that small part of it which is in contact with the porous diaphragm or partition) is in air under pressure, and the hydrogen liberated is free to escape or combine with its oxygen. One mode of constructing such batteries consists in connecting a number of porous cells with a gasholder-like reservoir, the bell of which is weighted to the desired pressure.

120. "Magneto-electric machines." H. F. JOEL. Dated January 9. 2d. Relates to a magneto-electrical machine for the conversion of dynamic energy into electricity by the rotation of a wheel or ring of inductors, through a series of magnetic fields, and it is designed to effect this by a simple and economical construction of machine. (*Provisional only.*)

125. "Electrical firearms and ordnance and cartridges therefor." E. A. MONFORT. Dated January 9. 6d. The invention is applicable more especially to breech loading firearms, muskets, fowling pieces and pistols, as well as to all sizes and kinds of cannon, howitzers, mitrailleurs, &c. The inventor provides a galvanic battery, or, preferably, a well charged storage battery (or a suitable dynamo machine or other source of electricity may be used) and connects the conducting wires of the same to contact points or contact surfaces which are exposed in the cartridge chamber of the arm. In one of said conducting wires he makes a break, and provides a button or other means analagous to a trigger for closing the circuit at that point when desired by an easy movement of the finger. He provides also another means of opening and closing the circuit to be set with the circuit open under ordinary circumstances, as a safeguard against accidental discharge. The cartridge is provided with two conducting wires which lead from the exterior into the powder charge, where they are connected with each other by means of a very fine wire of platinum, or other suitable material or metal, having considerable resistance, so as to become heated by an electric current. The contact surfaces in which the conducting wires from the battery terminate are so arranged that as soon as the proper manipulation is effected an electric contact is established with certainty through the conducting wires of the cartridge.

180. "Incandescent electric lamps." T. E. GATEHOUSE and H. ALABASTER. Dated January 11. 6d. Relates to electric lamps depending for their light upon the incandescence of a carbon filament, and is designed to simplify the attachment of the said filaments in the surrounding vacuum globes.

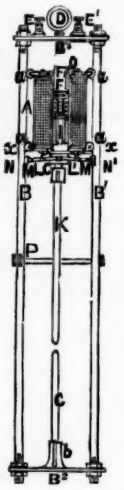
181. "Electrically controlling, &c., the speed of engines, &c." J. RICHARDSON (of the firm Robey & Co.) Dated Jan. 11. 6d. Relates to a method of regulating the speed of an engine electrically in conjunction with an ordinary speed governor which may be of any of the well known types, but instead of the governor acting direct upon the throttle valve or expansion link the mechanism is actuated by an electric motor or motors which open or close the throttle valve and increase or decrease the rate of expansion by any of the well known appliances. The apparatus would be so arranged that when the engine was running its normal speed it would be at rest, but immediately the governor slide was raised, contact would be made between the two ends of a wire, through which the electric current circulates, and an electric motor in the circuit would instantly start revolving and actuate the mechanism which would reduce the admission of steam which reduction would go on until the engine resumed its normal speed, when the electric contact would be broken and the motor would stop. The contrary of this would, of course, take place when, through increase of load, the governor fell, and by this means a practically constant speed would be maintained under great variety of load. The arrangement which is preferred is shown in the annexed drawings in which A, A is an ordinary governor, which may be of any of the well known types, occupying a constant position at a constant speed. B is a lever either forming part of the governor fork or so connected with it that it moves simultaneously with it. E is an electric motor so geared with the worm wheel, H, and the screw, I, that when the armature revolves in one direction the connecting link, F, is raised in the slot link, G, and the slide valve



of engine caused to cut off the steam at an earlier part of the stroke, and when the armature revolves in the contrary direction the connecting link, F, will be lowered and a greater admission of steam will take place. Two motors may be used if preferred to work in opposite directions, or one may have its magnets and armature so wound that it can revolve in opposite directions according to the manner in which the current is sent through it. The action of the governor is as follows:—As soon as there is the slightest increase of speed the lever, B, would make contact with the contact piece, C, thus, closing what was before an open circuit, the armature would revolve, and by raising the connecting link, F, would cut off the steam until the engine has resumed its normal speed, when the governor falling, contact would be broken, and the link would remain in the new position it had been compelled to take, the engine with its lighter load continuing to work at its normal speed. A reverse action would take place were the load increased, the governor falling would make contact between B and D, the armature would revolve in the opposite direction, and the connecting link would fall till enough steam had been admitted to again raise the governor and break the contact. It will thus be seen that whatever may be the variations in the load of the engine there is only one speed at which it is compelled always to run. When the engine is used for electric lighting the electric motor may be actuated by the current working the lamps, but when there is no such current a galvanic battery, electric accumulator,

or other source of electricity, may be used which gives a fairly constant current.

183. "Electric arc lamps." J. G. LORRAIN. Dated Jan. 11. 6d. Relates to improvements in that description of electric lamps known as arc lamps, and comprises various novel features hereinafter described, whereby an electric arc lamp of great simplicity and efficiency is obtained. The action of the lamp (which is shown by figs. 1 and 2) is as follows:—The carbons being apart in the first instance, the current passes through the shunt solenoid or sucking magnet, A. The upper soft iron core, F, is immediately sucked downwards, thereby lowering the upper carbon, while the lower core is sucked upwards, drawing up the pivoted inner ends of the two rods, L, L', releasing the pressure of the brakes or catches, N, N', upon the guide rods, B, B', and allowing the solenoid or sucking magnet and its attached parts to slide down until the



carbons are in contact. Thereupon the current, being free to pass by way of the carbons, is nearly wholly diverted from the solenoid or sucking magnet, and the elasticity of the spring, H, immediately reasserts itself. The lower core, G, is pushed down, and the catches or brakes, N, N', applied against the guide rods, B, B', whilst the upper core, F, is pushed upwards, separating the carbons, and so striking the arc. As the carbons gradually burn away the resistance of the arc increases, when more of the current necessarily passes through the solenoid or sucking magnet, thereby influencing the length of arc in the manner above described. This action is so continuous and rapidly recurring that the lamp when in use burns with the utmost steadiness.

205. "Posts for supporting wires for telegraphic, &c., purposes and electric lamps." C. E. J. MAY. Dated January 13. 4d. Posts for supporting telegraph or other wires for electrical purposes or electric lamps have often been made of iron tubes put together in convenient lengths, and various means have been adopted for joining those lengths together. The present invention consists in a method of joining them, which is simple and economical, and insures great stability in the united lengths.

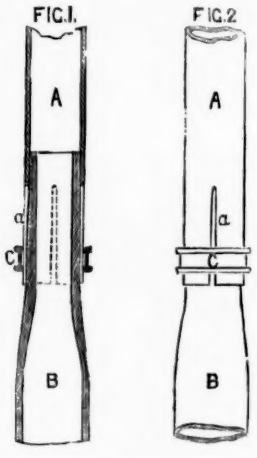


Fig. 1 is a vertical section, and fig. 2 a side view of part of a tubular telegraph post having the upper tube, A, jointed according to the invention to the lower or base tube, B. The upper part of B is a little tapered, and the lower end of A being cut with two or more longitudinal slits, *a* is pushed upon B, and then a ring, C, is forced or shrunk on so as to cause A firmly to embrace B.

CORRESPONDENCE.

The Mismanagement of Electrical Companies.

If we look back upon the past three years for some explanation of the present embarrassed condition of electrical industry, it is disheartening to discover the cause in a one-sided mismanagement of the commonest principles which govern every other industrial or commercial undertaking.

The startling contrast between the original prospectus inducements held out to obtain subscriptions and the confessions now, by precisely the same directors, of a semi state of insolvency of their schemes, cannot be accepted without some better evidence than that submitted to the public.

The transposition of large sums of money taken from helpless and, in too many melancholy cases, dependent shareholders, and put into the pockets of patent vendors and others, demand a more searching investigation than would appear up to the present moment to have been instituted.

Here one patent lamp figures for many thousands, according to the director's statement, then a dynamo, in the same way, is said to have cost as much, yet this lamp, for example, totally unlike that of Eastern fable, is profitable only once and that merely to the vendor when it is sold, and not to a soul afterwards.

Is it matter of any surprise that such companies are now financially gasping, and that the deluded shareholders are left out in the cold by directors who would seem to have left their personal responsible character outside their board-room the instant they entered it.

The art of manufacturing some prospectuses is by no means difficult: a good brush with bright colours and a few names which have been kept carefully bright before the public, and which may be utilised frequently by several companies, as they are sometimes too costly to be bought by any one incorporated body.

I have noticed in your independent journal frequent warnings against the pernicious policy which has pauperised many a worthy family; but what of that? say the directors: "let the galled jade go wince, *our* withers are unstrung;" and thus they escape scot-free; but should this, in all sense of righteous equity, be so?

Every means but a sound rational means has been adopted to impart a semblance of prosperity to some of these companies, and one of these means has been the getting up of installations in prominent places which looked like, and was intended by the directors to look like, a good business, and thus subscriptions have been obtained from a deluded public, for it has now come out, as the fact could no longer be concealed, that these very installations were so many decoys, being actually at the cost of the companies themselves; so that lamps, dynamos, gratis installations and costly boards of management have, like a sponge, absorbed all the shareholders' money, leaving nothing at last for working capital but a miserable inefficiency. Experience teaches that if a system is sound in itself, all the wrong doing of those who may cling to it, like so much fungi, will not stay its growth; it will grow from the temporary impediment, just as the railway system speedily rose from the effects of Hudson's pernicious policy; so that, in the present case, with the clearing away of much of the mal-administration under discussion, we may hope to see the electrical system in a more honest, flourishing condition.

Electrician.

Sir F. Bramwell on Telephones.

Referring to the proceedings of the British Association at Southport, reported in the *Times* of the 22nd inst., detailing the lecture of Sir F. Bramwell on telephones.

On perusing his remarks on telephonic science, which were of a very elementary character, I was surprised to find he did not allude to the discoveries of

that talented young electrician, Mr. Arthur French St. George, which have recently been subjected to severe tests by the scientific world, and have been noticed in your columns and by the press generally, and further, that no notice was taken by the speaker of Mr. St. George's invention for photographing the voice, certainly the most marvellous discovery of the age.

I observe that Sir F. Bramwell called the attention of his hearers to the advantages given to the public by the United Telephone Company, quoting from their circular the business transacted, the messages sent over the lines of the company within given periods, and furnishing details as to messages conveyed in the month of March last, particulars which have not been yet given to the public by the company.

The silence of Sir F. Bramwell on recent improvements and discoveries in telephonic science, and the prominence given by him to the doings of a commercial company, induced me to seek for a cause for these utterances of the lecturer, and I find that Sir Frederick Joseph Bramwell was called as a witness in the case of the United Telephone Company *v.* Alexander Maclean, Edinburgh, tried at Edinburgh in 1881-2, and that he stated in his evidence as follows :—

"In March, 1880, I became the allottee of 100 shares of the original Telephone Company; that company was united with the Edison Company, and they constitute the complainors' company; I hold 100 shares in the United Company, representing the 100 shares I had in the original company, *and I have added to my holding since.*"

From the aforegoing, it is not difficult to guess the object of Sir F. Bramwell in puffing the advantages of the United Telephone Company, and why he ignored the merits of recent discoveries in telephonic science. I think the public will be as surprised as I was to find that the British Association should be made the medium of puffing a commercial speculation by a lecturer, who is largely interested in the monetary affairs of a company to which he belongs.

Wm. D. Chester.

Selborne, Walton-on-Thames,
27th Sept., 1883.

[We think with our correspondent that some of the British Association papers savour more of "bold advertisement" than of science, but without going so far as to assign any probable reason which may have actuated Sir Frederick Bramwell's remarks, we cannot quite perceive why Mr. Chester should feel so aggrieved by the lecturer's omission of the "St. George" telephone. We are not aware of the severe tests to which this apparatus has been subjected by the *scientific world*, and surely, telephones which have been in operation for several years, are more properly those on which a lecturer should base his experiences, than those with which he has probably no practical acquaintance. Sir Frederick, doubtless, has his own opinion as to the merits and originality of Mr. St. George's invention, as had a correspondent whose letter "Patents for Telephones," appeared in our issue of Sept. 8th.—EDS. ELEC. REV.]

Boats Driven by Batteries.

Respecting the distance from London Bridge to Hammersmith, which Mr. Toynbee now declares to be nine miles one and a half furlongs in a direct line, I may state that if a course be pricked out on the conservancy chart it will measure eight miles three furlongs. The *De La Motte*, as far as I know, is the first boat that has been propelled upon the Thames by the electrical energy derived from a primary battery, but still I fail to see that your correspondent has made much improvement upon the experiment of Jacobi upon the Neva in 1839.

I can assure Mr Toynbee that, in calling his attention to the low rate of speed of his motor, I did not lose sight of the resistance caused by the rectangular section of the launch nor the pitch of his propeller, but I would suggest that in future descriptions of similar experiments he would favour us with the electrical horse-power of his battery.

$$\frac{\text{Electromotive force} \times \text{current in Ampères}}{746} = \text{horse-power,}$$

and also the corresponding work done upon the shaft, measured by dynamometer during a given rate of speed, and then the actual efficiency of his motor could be valued.

Also, by taking the current in ampères passing through the motor when at rest, and comparing it with the current passing, when the motor is making, say, 100 revolutions, and again, when it runs at 265, Mr. Toynbee will probably understand the value of counter-electromotive force. I know that the construction of the "patent motor" is such that a high speed is impracticable, and to attempt to increase the present rate to any extent would be simply to waste the electrical energy in heating the armature and destroying the insulation of its wires.

It is true that I did not dispute his claim to be the originator of ball bearings in launches, but I cannot see that, under the circumstances, he gains much by their use. I have found, during a considerable experience with launches, that the packing in the stern-tube stuffing boxes and the thrust block absorbed more energy in overcoming their friction than even the many bearings of the steam-engine; and when we dispense with the friction caused by the piston, piston-rod, cross-head and guides and the connecting-rod, with all the irregularity attending the conversion of reciprocating into rotary motion, one would reasonably suppose that more attention should be devoted to the laws controlling the action of electro-motors than to making a speciality of reducing the slight friction of the two bearings. With all due respect to Mr. Toynbee, and despite its non-scientific style, I cannot, in the face of this, withdraw my quotation of the "gnat and the camel."

Frederick Walker.

34, Loys Road, Bruce Grove, N.

My attention has been called to Mr. Toynbee's letter in your issue of 29th ult., in which he states his boat, the *De la Motte*, to be the first electrically driven direct on the shaft. Allow me to correct this, as I had one tried on the Clyde, at Kilcreggan, in March, and another in May, both so driven, whereas Mr. Toynbee's vessel only appeared in June.

A. C.

In answer to the letter of Mr. C. Bennett with reference to the quantities of sulphuric and nitric acids, as well as the weight of zinc used in my trial of the *De la Motte*, it will only be necessary to tell him that such quantities were determined by analyses of partially spent residuary liquors. The battery was made by the Vulcan Manufacturing Company, where, no doubt, Mr. C. Bennett will be able to procure the information he requires.

Edward Toynbee.

18, Malvern Villas, Willesden,
October 3rd, 1883.

"Will Atlantic Traffic Support Two New Cables."

The question you have asked, and undertaken to answer, in your number 304, dated the 22nd instant, *i.e.*, "Will Atlantic traffic support two new cables," is not at all the question at issue between promoters of new Atlantic cable companies and the public willing to invest money in such enterprises.

Investments in Atlantic cable property can now be made in the existing companies, at a very considerable discount, to pay quite as well, and in some cases better, than the 7½ per cent. which you show as the maximum dividend of a new cable company at the 2s. rate, and consequently unless the prospectus of a new cable company contained an absolute undertaking to reduce the existing tariff of 2s. per word to 1s. per word, or less, it would be hopeless for promoters to endeavour to raise capital for the purpose merely of multiplying the number of cables already laid, which are more than sufficient to carry all the traffic at present rates.

The question which proposing investors and the public would desire to see answered is—

"Will Atlantic traffic support two new cables *at an uniform tariff of* 1s. *per word?*"

and this question you have certainly not answered satisfactorily.

The following figures will show what profit your estimated traffic at 1s. per word—*i.e.*, £607,640 per annum—will pay a new cable company with a minimum capital of £1,200,000.

$\frac{2}{10}$ths of £607,640 is equal to		£122,000
Deduct working expenses of two cables	£56,000	
Renewal fund, 5 per cent. on capital of £1,200,000	60,000	
		116,000
Leaving a balance of		£6,000

There are other charges which would more than consume the small balance of £6,000, such as sums paid out to connecting companies, and the expenses of a repairing ship, without which no cable company can hope to maintain their proportion in the gross traffic, and for which no provision has been made in the foregoing figures.

You lay some stress upon the fact of your calculations being based on existing figures, and making no allowance for the certainly-increasing traffic by telegraph; in adopting that course you have done wisely, as the traffic between Europe and America has been for some time past stationary.

H. Weaver,
Managing Director.

Anglo-American Telegraph Company, Limited,
26, Old Broad Street, London, E.C.,
27*th September*, 1883.

[We are always pleased to hear from a correspondent whose familiarity with his subject is as great as is that of Mr. H. Weaver. In the present instance we think, however, that he misses entirely the point which he apparently wished to score. We would first say that we did not propose, in the article he quotes, to answer every possible question concerning Atlantic telegraphy, but only one specific question, and that was, we fancy our readers will allow, somewhat completely considered and the answer given. Mr. Weaver now asks another question—namely, Will Atlantic traffic support two new cables at an uniform tariff of 1s. per word? In the second paragraph from the end of the article, to which Mr. Weaver alludes, he will, if he look carefully, find our opinion expressed as to what would result if a 1s. rate were introduced. It runs as follows:—"The two new cables would, therefore, during a shilling rate, receive about 5 per cent. for their money, and leave 3 per cent. to carry to reserve fund, &c. During this time the other companies would be paying only one-half of this rate to the shareholders." Under such circumstances would the now existing companies be likely to maintain a 1s. rate unless forced so to do? We think not.—EDS. ELEC. REV.]

Electrical Railways.

I am certainly surprised and amused after reading an article in your impression of the 25th August last, giving an account, or rather, I suppose, I ought to style it a description, of "The Electric Railway of Chicago," which is elaborately illustrated, and spoken of as "a leading novelty and great achievement."

Now considering, with the exception of Messrs. Siemens and Halske, I am the only one, not only in England or the United States, but on the Continent, who has, during the past two years, run an electric railway uninterruptedly, and this I have under my own personal superintendence. This being so you will at least admit that I am entitled to have some voice with your readers on the subject of this so-called "great achievement."

Having regard to the progress made in electric railways, you will, I feel sure, pardon me saying that the article above referred to would not only have been better worth your publishing, but would have been far more appreciated by the electrical scientific world some four or five years since than at the present time, as, for instance we would ridicule a report published in this year (as a "new sensation") on an arc lamp as constructed for experimental lectures 10 years ago.

I certainly fail to find one single item in the whole description which is novel, even the interesting feature, the device (by means of which the current is reversed), has more than 12 months since been published and illustrated in your own journal, and as to the laying of the wires under the rails, as stated, and which evidently it is endeavoured to show is something greatly beneficial, it is clear to every one possessing but a slight knowledge of electric railways that such an application is not only wholly useless but absurd.

According to your information, Messrs. Field and Edison are the inventors of this most marvellous system; of course, we are all open to correction, but up to the present I was under the impression that it usually required at least one man to invent something, but by means of this article I have been enlightened to the fact that it takes two clever men to invent nothing; but certainly the most facetious paragraph in the whole matter is that wherein it is stated that the locomotive, and "child of Mr. Field's genius," has been christened "The Judge," after his uncle, who has had the honour of being raised to the high position of Lord Chief Justice of the United States. As I read it, either Mr. Field must be acknowledged to be the best "judge" amongst his brother electricians, or his uncle, the Lord Chief Justice, the best electrician amongst his brother judges, otherwise such names as Volta, Ampère, Orestas, Faraday, Ohm or Watts would be more appropriate, as I feel sure you will agree.

The table which I give at foot will, I think, prove that I have at least not overstepped the mark in writing as above on the so-called "American novelty and great achievement" in this branch of electricity.

H. Binko.

The International Electric Railway,
Crystal Palace, Sydenham, S.E.

	Chicago Electric Railway, 1883.	Crystal Palace Railway.
Name of Locomotive.	"JUDGE"	"OHM."
Weight of do.	3 tons	1¼ ton.
Size of do.	12 ft. × 5 ft.	6 ft. × 3 ft.
Draws	1 car—16 passengers	3 cars—39 passengers.
Weight of Generator.	2,700 lb.	1,500 lb.
Length of Track	1,553 ft.	1,500 ft.
Gradient	None.	1 in 15.
Curves	Regular / 66 feet radius	Irregular. 45 radius.
Speed	7 miles per hour	25 miles per hour.
Line	Covered, consequently always dry	Out-doors, runs fair or wet at equal speed.

[The description and illustrations of the article in question were placed at our disposal by the New York *Electrical World*, and the expressions quoted by Mr. Binko are not ours. The only editorial remarks by us, to which we would refer our correspondent, will be found on p. 133 of the same issue of the ELECTRICAL REVIEW, as that from which he quotes. Mr. Binko rather oversteps the mark when he places Watts (*sic*) amongst electricians, and we would ask, who is Orestas?—EDS. ELEC. REV.]

The Hammer Telephone.

I am obliged by M. De Locht-Labye's reply to my letter, contained in your issue of September 1st. It has helped me to a better apprehension of his views, which are certainly not the same as my own, and the evidence he adduces is no proof "to my mind" of the truth of his theory. I shall therefore watch with interest for the publication of the complete work he promises.

F. W. Cooke.

Telegraph Department, G. N. Railway,
Retford, *October* 1*st*, 1883.